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MARIA JOSÉ DIAS CAROCINHO SOUSA

Dilemas do Conhecimento: a Perspectiva de duas Organizações Portuguesas

Knowledge Dilemmas: the Perspective of two Portuguese Organisations

GESTÃO DO CONHECIMENTO

GESTÃO INDUSTRIAL

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dissertação apresentada à Universidade de Aveiro para cumprimento dos requisitos necessários à obtenção do grau de Doutor em Gestão Industrial, realizada sob a orientação científica do Doutor Joaquim Borges Gouveia, Professor Catedrático do Departamento de Economia, Gestão e Engenharia Industrial da Universidade de Aveiro e do Doutor Peter Totterdill, Visiting Professor at Kingston University, Inglaterra.

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Dedico este trabalho ao meu filho Miguel Sousa.
I dedicate this work to my son Miguel Sousa

o júri

presidente	Doutora Maria Celeste da Silva do Carmo, Professor Catedrático da Universidade de Aveiro
	Doutor Richard Ennals, Full Professor at Kingston University, Inglaterra
	Doutor Joaquim José Borges Gouveia, Professor Catedrático da Universidade de Aveiro
	Doutor Henrique Manuel Morais Diz, Professor Catedrático da Universidade de Aveiro
	Doutor Joaquim da Costa Leite, Professor Associado com Agregação da Universidade de Aveiro
	Doutora Leonor Maria Gonçalves Pacheco Pais Andrade Cardoso, Professora Auxiliar da Faculdade de Ciências e Tecnologia da Universidade de Coimbra
	Doutor António Carrizo Moreira, Professor Auxiliar da Universidade de Aveiro
	Doutor Peter Totterdill, Visiting Professor at Kingston University, Inglaterra

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palavras-chave

Conhecimento individual, conhecimento tácito, conhecimento explícito, inovação organizacional, partilha de conhecimento.

resumo

A presente investigação pretende examinar se existe uma convergência entre as diferentes percepções dos actores organizacionais, no que respeita à criação e uso/partilha de conhecimento durante o processo de inovação e mudança organizacional. Iremos igualmente tentar compreender se o conhecimento individual – técnico e organizacional – tem impacto na inovação organizacional e no processo de mudança e, consequentemente, no rumo da organização. Iremos conceptualizar o conhecimento individual como conhecimento tácito e assumir que poderá impulsionar a inovação organizacional e, consequentemente, o desenvolvimento da organização. Contudo, iremos assumir que a partilha do conhecimento explícito não poderá ser separada do processo de compreensão, sendo necessário o conhecimento tácito individual para completar a partilha. O conhecimento explícito e o conhecimento tácito serão ambos estudados como dois elementos inseparáveis porque consideramos que o conhecimento explícito necessita de uma compreensão tácita da linguagem que estrutura o conhecimento explícito.

Neste contexto, este estudo apresenta as conclusões acerca dos métodos e formas de interacção e partilha de conhecimento entre os actores organizacionais no que toca à inovação organizacional e aos processos de mudança. A informação será recolhida por via de entrevistas e a técnica Group Recall usando a metodologia de investigação-acção. Este estudo contribui, de várias formas, para o desenvolvimento de um quadro teórico e empírico sobre o conhecimento e a partilha de conhecimento tácito em contextos de inovação organizacional e de processos de mudança. Em primeiro lugar, identifica e analisa as diferentes percepções dos actores organizacionais sobre a partilha e o uso do conhecimento individual durante os processos de inovação organizacional. Em segundo lugar, apresenta o impacto do uso do conhecimento individual partilhado e/ou criado durante os projectos de inovação organizacional nos processoe e práticas da organização. Em terceiro lugar, propõe um conjunto de perfis de conhecimento que podem potenciar a criação e partilha de conhecimento entre os actores organizacionais. Em quarto lugar, sugere um modelo facilitador da partilha de conhecimento que pode servir de referência para investigadores e para profissionais das organizações em processos de inovação organizacional e de mudança. Finalmente, este estudo propõe algumas direcções para futuras investigações e sugere algumas questões de estudo que emergiram desta investigação e que poderão ser exploradas.

keywords Individual knowledge, tacit knowledge, explicit knowledge,organisational innovation, knowledge share.

abstract This research examines if there is a convergence between the different perceptions of organisational actors regarding to the creation and use/share of knowledge during organisational innovation and change processes. We will also try to understand if individual knowledge – technical and organisational – impacts in the organisational innovation and change process and consequently in the organisation's direction. We will conceptualize individual knowledge as tacit knowledge and assume that it may boost organisational innovation and consequently company development. However, we will assume that the share of explicit knowledge cannot be separated from a process of understanding, needing the individual's tacit knowledge to complete the share. Explicit and tacit knowledge will be studied as two inseparable assets, because in our assumption explicit knowledge needs a tacit understanding of the language in which explicit knowledge is structured. In this context, this study presents findings about methods and forms of interaction and knowledge sharing between organisational actors in organisational innovation and change processes. Data will be collected through interviews and group recall techniques using the Action Research methodology. This study contributes to the body of knowledge about tacit knowledge sharing in organisational innovation and change processes in several ways. Firstly, it identifies and analyses the different perceptions of organisational actors about the use of individual knowledge during the process. Secondly, it presents the impacts of the use of individual knowledge shared and created in the organisational innovation and change process in the organisation strategies. Thirdly, it proposes knowledge profiles as facilitators of knowledge sharing between organisational actors. Fourthly, it provides a model with several guidelines for researchers and practitioners that they can use in organisational innovation and change processes supported by knowledge sharing. Finally, the study provides directions for avenues of future research, and suggests some research questions arising out of these findings that might be explored.

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“Existirá alguém tão esperto que aprenda pela experiência dos outros?”

Is there anyone as smart as to learn from other people’s experience?

Voltaire (1694-1778)

CHAPTER 1 – INTRODUCTION AND METHODOLOGICAL DEFINITIONS

1.1 Introduction

This chapter presents the research problem, its approach is defined and the motivation and main objectives of this investigation are introduced. The conceptual and technical contributions of this research are also presented. This chapter ends with an overview of the thesis structure and its content.

1.2 The motivation for the research

The initial motivation for this research was to bring together organisational innovation and change, and knowledge theories. The trigger for this work was to understand the different perceptions of organisational actors regarding the creation and use of individual knowledge during organisational innovation and change processes. A further motivation was the desire to build an effective organisational model that helped the organisation to promote the use of individual knowledge in organisational processes.

1.3 The research approach

The starting point for the work was an interest in an interdisciplinary approach, bringing together the research fields of organisational innovation and change and knowledge management. This thesis will present an integration of these areas in a cross-disciplinary research approach to Knowledge Management – using action research methodology.

For the use of individual knowledge to be effective, an organisation needs to create a culture that promotes involvement and participation and continuous learning using mechanisms to exchange experiences and expertise.

The research focuses on particular knowledge assets termed “tacit knowledge” that is introduced in the context of competence management within the organisation. A less tangible knowledge asset is interpreted as a knowledge source that is difficult to identify, such as an unknown (or undocumented) employee competency or the definition of the organisational context in which information is created and used in the workplace.

Finally, the research assumed a collaborative approach to the organisations, allowing the creation of a relationship of shared knowledge not only between the researcher and the organisational actors that have participated, but also between the organisational actors themselves, allowing a better knowledge of the organisation.

It is also important to point out the relevance of this research when combining organisational theory with knowledge theory. The proposed theory and implementation have many potential applications, but some theory weaknesses need to be referred, like the diversity of isolated theories within organisational theory.

Another weakness is the assumption that all organisations are somehow alike in classical organisational theory. This research tries to point out the differences and the specificities of each organisation and the different management styles.

Employees have their own personal motivation for sharing, and have differentiated needs-orientation.

However, in most research work, theory does not take into account the fact that all organisations have specificities and need to be studied as a unique phenomenon (Thompson and McHugh, 2002).

In quantitative research, hypotheses about organisations are also developed in general ignoring the distinctive nature of management, control and other social relations in each organisation.

In addition, this study tries to put an emphasis on the learning side of knowledge transfer and in competencies development process.

This research tries to fulfil this gap in most part of literature, analysing the specificities and the individual's perceptions about individual knowledge sharing process.

1.4 The empirical work

The thesis examines the perceptions of all organisational actors about the employee's use of their individual knowledge to help the organisation in the organisational innovation processes. For this purpose, several group recall sessions where made to different hierarchical organisational actors. The high-level goal of this thesis is to create a model that can facilitate the individual knowledge sharing.

The empirical work was organised in four stages. The first stage was a visit to each organisation (EFACEC Automação e Robótica and BOSCH TERMOTECNOLOGIA

SA) to explain this project's goals and in the latter (BOSCH TERMOTECNOLOGIA SA), there was a visit of the plant included in which the Bosch Production System Manager explained all the production process, and the organisational innovation processes in course.

The second stage concerned the establishment of group recall sessions and data collection. The third stage included data analysis and the communication of data to each organisation. The fourth part addressed the creation of the model and its evaluation by the organisations.

1.5 The contribution

The principal contribution of this research is to the existing literature concerning organisational innovation and change and the liaison with knowledge theories.

This research also intents to create a body of knowledge about tacit knowledge sharing and the potential organisational implications of this process.

1.6 Research questions

The research questions, specially the first one, are grounded on the existing literature and it is very relevant for the practitioners and the organisations themselves.

This research question helps the researcher to seek evidence from multiple sources about means and ways of knowledge sharing and the specificities of each source perception about that process. The main goal is to learn from and through the organisation practices and workers perceptions.

The design of the research was discussed with an interlocutor in each organisation that participated in the research and it was found interesting to analyse each of the organisational actions perceptions according to their hierarchical position, about: a) the possibilities of sharing and using individual knowledge, accumulated throughout life and professional experiences; b) to solve organisational problems; c) to innovate at organisational level; d) the existing mechanisms in the organisation to promote the sharing; and e) if the organisation integrates and effectively uses new knowledge created or developed by them.

Using these five issues, this research tries to look at individual knowledge questions supported in four organisational dilemmas that are supported in the fact that individual

knowledge is a resource that companies can use to provide an answer to the challenges that the general environment requires.

In this context, the following research questions are introduced:

a) *Is there a convergence in the perceptions of the different organisational actors about the effective use of individual knowledge in organisational innovations processes?*

b) What are the lessons learned to promote individual knowledge sharing during organisational innovations processes?

The first research question has a great potential impact on organisations and in the workplace. The understanding of the perceptions of each hierarchical level about knowledge sharing in the organisation can bring several benefits to a better share and use of knowledge, and also promote the creation of new knowledge.

Another goal of this research was also to study how knowledge sharing among all the actors contributed towards a better understanding of their situation in order to affect a positive personal and organisational change.

The collaborative participation of all actors with the researcher is a crucial factor of success, so it could be possible to learn some useful lessons based on the interaction and in the reflection process in order to take further action in the promotion of the use and share of the individual knowledge in the organisation.

1.7 Research goals

The research sets out to identify and explore the scope for intervention by organisational key actors such as employees and Managers and to explore action research as the foundation for shared knowledge creation and learning between actors.

In this context, there are related aims that are addressed in this research:

- Critical review of literature, including the appraisal of competing theories, explanation and evidence of organisational innovation and change.
- Creation of a framework for individual knowledge use/sharing in the organisational innovation and change context.
- Emphasis on the roles of organisational actors in the use/sharing of knowledge process.

- Development of a methodological approach through action research based intervention in the workplace level with the purpose of analysing the convergence between organisational actors about the use of individual knowledge during organisational innovation and change processes.

To address these questions in this research, first we began with a literature review on the theories of innovation and organisational change and knowledge, followed by empirical evidences concerning success cases of innovation and organisational change. The next phase will reflect the empirical studies in two different organisations – one with high qualified workers and another with employees who have a week level of qualifications.

1.8 Research dilemmas

When we analyse the organisational and innovation literature we found innovation as one of the most important strategic/management dilemma. The organisations survival implies that they became more and more competitive and innovation, especially organisational innovation, can be a key solution. However, very few organisations invest in a very consistent way in an organisational innovation strategy. The answer for this phenomenon is itself a very important and complex dilemma because the importance of organisational innovation for competitiveness is not explicit and the choice between investing in technology and investing in people always raises some questions about short and long term survival of the organisations.

In a microanalysis, we see some dilemmas arising when we try to understand the interactions between the organisational actors and if their knowledge affects the organisation's dimensions.

In the context of this research we will analyse strategic/management dilemmas and will conceptualise them as to point out situations where organisations continuously face dilemmas, and determine what is their responses to these situations, and, over time, how do they succeed.

1st Dilemma: "Literature emerges the idea that the use of individual knowledge accumulated through life and professional experiences is a competitive advantage for the organisations' success. However, sharing and transferring inexpressible knowledge is almost an impossible task to accomplish."

Knowledge sharing and transference requires specific competences of interaction. One of the main factors of successful knowledge sharing is a trust climate among workers. This makes them more participative and more involved.

With respect to workers' interactions, the assumption is that the individual learns and then affects the group with the new knowledge he has acquired, but he needs to be inserted in an organisation which purpose is developing individuals and producing skills and innovation for the organisation (Jacobs and Washington, 2003).

On the other hand, transforming tacit knowledge in explicit knowledge, namely life and work experiences and all the knowledge that workers develop and store along the years, seems to be a very difficult activity because it represents knowledge that people possess, but which is inexpressible and incorporates both physical skills and cognitive frameworks.

However, when the knowledge becomes explicit it can be passed on and acquired by another person (Morris and Beckett, 2004). Several research works about workplace learning also imply the assumption that individuals acquire knowledge, for example, by listening to information presentation and when this becomes common practice, they become more open to share it with other colleagues.

2nd Dilemma: "The use and share of employees' individual knowledge is an important factor to solve problems and strengthen performance. However, several organisational and individual barriers condition the process."

Organisations use particular processes in order to solve problems - testing new and different ideas on how to achieve success is one of this processes and employee's individual knowledge can perform a relevant role in it.

However, employees do not always have the capacity to use their knowledge to help their organisation to solve problems and respond to challenges because organisations do not always give them space to think, act, make informal contacts, gain experience,

experiment and take risks. In many situations, employees and even Managers find it difficult to use the knowledge that they have developed in other working experiences simply because it was not requested.

To stimulate the use of individual knowledge and strength the core competencies of organisation, top management can promote a learning attitude, intensive knowledge exchange and internal entrepreneurship. It is also possible to use an approach to problems through precise routines, procedures and methods like brainstorming, problem-solving cycle and risk management.

Jashapara (2007) refers that “organisational routines provide the contingent condition or `spark' to activate organisational knowledge processes”. The processes can be initiated and guided by existing or expected problems that are seen as a chance to learn or innovate.

Managers can focus themselves on developing and mobilizing employee’s knowledge to innovate and introduce new practices using tools like mapping out the individual competencies of each employee - it will help to understand which employees have valuable knowledge and what the existing knowledge gaps are in order to take some measures to narrow and eliminate them. They can also create more “communicative knowledge-accomplishing activities, which frame and respond to various problematic situations” (Kuhn and Jackson, 2008).

Nevertheless, organisations need to have a high level of openness to risk and tolerance to mistakes and failures instead of penalizing employees for them. Only this perspective allows organisations to create a culture of innovation.

3rd Dilemma: “Using and sharing individual knowledge is crucial to organisational innovation processes, but organisational culture and management resistance makes it very difficult to promote employee’s involvement and participation.”

Organisations can promote and invest in a learning environment characterized by positive thinking, self-esteem, mutual trust, willingness to intervene preventively, taking responsibility for business performances and rewarding the employees who continually study their work and give ideas to better it when needed.

Skilled workers are more open to innovation and change because accepting new work practices is easier when the skill level of the workforce is higher and a skilled labour

force will accelerate the introduction of organisational changes because skilled workers are more able to analyse and synthesize new pieces of knowledge (Caroli and Reenen 2001).

However, knowledge and learning competences need to be a part of every employee's competence profile and organisations can have an important role stimulating employees to think about, identify and solve common problems; to let go of traditional ways of thinking; to constantly develop their own skills, and let them acquire experience and feel responsible for organisation and team performances.

Under the employee's perspective, it is interesting to analyse their position about the balance between their own personal ambition and the shared ambition of the organisation. In the literature we can find two kinds of workers: a) Individuals who care about the organisation and what it stands for, those with the vision, competence and resources to apply what they have learned to make the company and themselves the best they can be; b) Individuals who would be satisfied with the fact that their Manager takes all the responsibility and they just do what they tell them to do.

Finally, it's important to take a look at the leadership style - it is crucial for leaders to coach, help, inspire, motivate and stimulate; to be action-oriented and that give feedback about improvement actions undertaken. A participative style can be used as an advantage to the decentralization of decisions and the communication process to involve employees. Leaders should become facilitators instead of barriers to organisational innovation and change.

4th Dilemma: "Organisations need to promote individual knowledge sharing among all organisational actors, but organisations don't see the need of creating mechanisms to promote this sharing."

Top management can have and important role in the promotion of dialogue, creating conditions whereby people are willing to apply their knowledge, share it and exchange it with each other. Developed knowledge can be continually documented through reports, images or even metaphors, and made available to everyone in the organisation.

Informal contacts, internal lectures, conferences, problem solving and project review meetings, dialogue sessions, internal rapports and memos are important means to share knowledge. Organisations can also use some mechanisms that facilitate

knowledge sharing: the Internet, the Intranet, the library, comfortable meeting rooms, an auditorium, a computerized archive and even a documentation system.

To reinforce dialogue organisations can develop a proactive competence policy, which may include internal and external training, courses, working conferences, symposium, seminars and informal employee contacts.

The organisation can also create networks of knowledge with workers with different backgrounds for developing new knowledge using several processes to develop and share knowledge like using images, metaphors and intuitions.

Not only the internal actors perform a relevant role in the process of organisational innovation and change, but also external actors, like universities, consultant companies, trade unions and others. As innovation agents, their involvement can be important for the organisational development itself.

5th Dilemma: "Knowledge is recognised by researchers and practitioners as a fundamental asset to organisations survival. However, organisations don't integrate and effectively use new knowledge created or developed by employees."

In some organisations, knowledge is constantly being implemented and incorporated into new products, services and processes. For instance, processes like benchmarking is done systematically to gain new knowledge and develop new practices or new business models.

The organisation itself promotes critical thinking development and applies it in the workplace, constantly developing employees' knowledge by means of training, coaching and talent development programs.

However, some organisations have difficulties to integrate and effectively use new knowledge in the job description. Even workers and Managers rarely use knowledge from training courses or self-development processes.

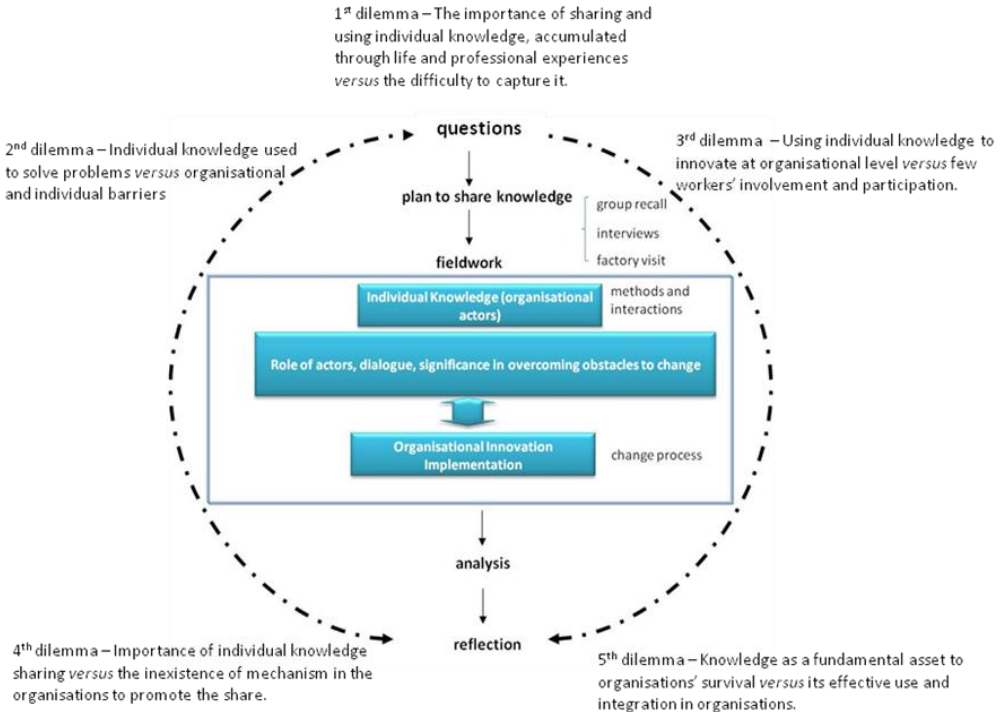
Also, an important dimension for knowledge integration is the need for a coherent company-wide social identity instead of a multiple community or group based social identity in order to promote effective knowledge integration in organisations (Willem et al., 2008).

1.9 Research model

With this research we can study if behind the initiatives of the organisations lays an assumption that individuals and groups can cope and use their knowledge to help the organisation with the innovation and change process and, at same time, if they can learn from incidents and actions.

The defined research dilemmas are going to be the guidelines of all theoretical and field research, as we can see in the next figure where the research model is presented:

Figure 1 – The research model



All the fieldwork is going to be supported by a set of questions and issues according to each dilemma and all the conversations and knowledge sharing between all the organisational actors and the researcher will be associated to the dilemmas.

Table 1 – Questions in debate – Group Recall Sessions

1st dilemma	Knowledge sharing and transference in the factory
	Understanding explicit knowledge in the factory
	Transforming tacit knowledge into explicit knowledge
	Knowledge sharing and transference in the factory

2nd dilemma	Mapping the most important knowledge and competencies for the organisation
	Employees with valuable and scarce knowledge
	Using and sharing knowledge to help the organisation respond to challenges
	Using knowledge in problem solving
	Barriers associated to the introduction of new knowledge
	Mapping the most important knowledge and competencies for the organisation
	Manager's role in promoting employees' participation in using new knowledge and sharing their own knowledge.

3rd dilemma	Knowledge culture
	Space for workers to analyse their work
	Managers' role

4th dilemma	Suggestion boxes
	Workshops
	Knowledge networks

5th dilemma	Integration of new knowledge and its effective use in the day-to-day work
	Incorporation of new knowledge into new products, services and processes
	Implementing practices from other organisations

In the analysis of the dilemmas, we assume that an organisational dilemma demands organisational learning. If this learning process is not happening, then we should ask why. It is our intention that the answers that will emerge from the field work will help us understand the potential gap between the perceptions of Managers and workers. For instance, it is important to analyse the metaphors carried by employees in the organisation and try to explain why they are not understood or considered by Managers. Other important issue that can be analysed is that the visions perceived by the employees concerning the future of the organisation and themselves are not always consistent with the visions perceived by the Managers.

1.10 Thesis Structure

1.10.1 Chapter contents

This thesis is structured in ten chapters.

Chapter one gives an overview of the research.

Chapter two analyses the conceptual background of the research: organisational innovation and change and knowledge theories. It presents a literature review in these fields, including specific knowledge management approaches and organisational innovation theories.

Chapter three includes a literature review and analyses Action Research methodology in the field of innovation and organisational change.

Chapter four presents the Action Research methodology applied to the field work and the research role in the process.

Chapter five presents the research approach and process in the two Portuguese organisations used for the development of this research.

Chapter six presents a model proposal for individual knowledge share and use as a consequence of the field research.

Chapter seven explores the main achievements of this research, using a participative and qualitative methodology, involving several organisational actors in the process, and using the group recall technique.

Chapter eight presents the conclusions and future work, closing this thesis. It presents a summary of this research including some lessons learned, limitations, and methodological issues. It discusses the contributions of this research work and future work required to promote the creation and share of individual knowledge during organisational innovation and change processes.

1.10.2 Appendix contents

This document contains eight appendixes (A-H):

Appendix A presents the questionnaire used in the first interview with the Innovation Manager of EFACEC Group and General Manager at EFACEC, Automação e Robótica and Bosch Production Manager in BOSCH TERMOTECNOLOGIA SA.

Appendix B presents the questionnaire focusing on the organisational and knowledge dilemmas. This questionnaire was used with the Operators.

Appendix C presents the questionnaire focusing on the organisational and knowledge dilemmas. This questionnaire was used with the Technicians.

Appendix D presents the questionnaire focusing on the organisational and knowledge dilemmas. This questionnaire was used with the Managers and Middle Managers.

Appendix E presents a questionnaire that was suggested by EFACEC about the impact of individual knowledge use in the organisational innovation process.

Appendix F contains a project description and objectives proposed to the organisations.

Appendix G contains the research's work plan.

Appendix H contains a paper presented in the International Forum CRITEOS about the knowledge and innovation process in EFACEC, Automação e Robótica that was also an internal report to the organisation.

CHAPTER 2 – LITERATURE REVIEW ON ORGANISATIONAL INNOVATION AND INDIVIDUAL KNOWLEDGE

2.1 Introduction

This chapter begins with a description of the main features of organisational theories, including navigation in organisational innovation context: types of organisational innovation, nature of innovation, facilitators and obstacles, origins and impacts.

It also includes the conceptualization that individual knowledge is a critical source of organisational knowledge and explores the link between individual knowledge use and organisational innovation processes.

This literature review concerning the research questions tries to create a frame for the organisational innovation process, which was a criterion for the field research. In this context of organisational innovation, it was important to analyse its implications in the effective use and share of individual knowledge, linking them to the knowledge management theories.

2.2 Organisational Theory

Several authors (i.e. Egeberg, 1984; Scott, 1992; Bukve, 1994) have classified organisational theory into different theoretical perspectives: rational, natural, open system perspective and new-institutionalism.

On one hand, we have the rational and the natural perspectives that tend to view the organisation as a closed system, separated from its environment and with easily defined groups of participants.

The rational system perspective include: Frederick W. Taylor's Scientific Management (1911) and Henri Fayol's (1949) administrative principles, followed by Luther Gulick and L. Urwick's (1937) principles for coordination and specialization, Max Weber's theory of bureaucracy (1947, 1968) and Herbert Simon's administrative man (1947).

In this perspective, organisations are seen as instruments designed to attain specific goals. Behaviour is precisely and explicitly formulated and prescribed independently from the personal attributes of individuals occupying certain positions in the structure.

In the natural system perspective, organisations consist of social groups attempting to adapt and survive in particular circumstances. The main approaches of the natural system perspective are: Robert Michels' iron law of oligarchy (1949), Elton Mayo's

“Hawthorne effect” (1945), Talcott Parson’s social system AGIL (1951), Philip Selnick’s institutional approach (1948, 1949, 1957) and Michel Crozier’s (1964) “dysfunctional” aspects of rational behaviour.

On the other hand, we have the open system perspective that shows organisations embedded in larger systems and as parts of various subsystems that are interlinked and interact.

Selected schools of the open system perspective are for example: organisations as loosely coupled systems (Cyert and March 1963; March and Olsen 1976; Pfeffer and Salancik 1978), David Easton’s political system (1953), Jay Galbraith’s contingency theory (1973), Karl Weick’s cognitive model (1969, 1976), and system design theory (i.e. Ashby 1956; Burns and Stalker 1961; Mintzberg 1979, 1983; Perrow 1984).

“New institutionalism” is to be found within economic organisation theory, political science, history and sociology. It expresses a common conviction that institutional arrangements and social processes matter. The development of these approaches is, to a certain extent, a reaction against the behavioural revolution and has its theoretical roots in the political economy associated with the functionalist thinking of Talcott Parsons (i.e. 1951, 1960) and Philip Selznick (i.e. 1948, 1949, 1957).

New institutionalism emphasizes that organisational behaviour takes place within an institutional context, and that the institutional context shapes the behaviour within the organisation. The institution represents an institutionalized understanding – that is the “common understandings that are seldom explicitly articulated” (Zucker 1983:5). Any organisation is ambiguous, but organisational norms and routines for appropriateness evolve gradually and reduce ambiguity.

Learning theory, which emphasizes how individuals in institutions organize information in social categories (Rosch et al. 1976; Rosch 1978; Fiske 1982; Kulik 1989), has a distinct role in the new institutional theory. According to March and Olsen, institutions also learn from their experiences through accumulating historical experiences (March and Olsen 1975; Levinthal and March 1982; Olsen 1992; Brunsson and Olsen 1993; Olsen 1996; March 1999). Results and inferences of past experiences are stored in standard operating procedures, professional rules and rules of thumb. Institutions learn along several dimensions related, for instance, to modification of strategy, competence and aspiration, and the interaction of these dimensions.

2.3 Organisational Innovation and Individual Knowledge Sharing

The focus of this research will be on organisational innovation in the perspective of organisational studies on innovation and the process of knowledge sharing among individuals into the organisations. The main idea is not to create an historical framework of these theories but to use them as analytical models that could help guide and the interpretation process of the empirical research.

We found in the literature that new understandings about knowledge sharing processes appear to be emerging, and different issues and questions for research appear to be generating a wide range of empirical and theoretical research. It is fully understood that the research area of knowledge share is a critical one in the current era of the knowledge economy as we point out in the 1st dilemma of this research.

Previous studies have channelled much effort into understanding how knowledge transfer and share could be facilitated efficiently. Yet, most of these studies conducted research only at the mechanisms of the knowledge transfer and mainly concerning the technological level, ignoring the fact that, in many organisations, the individuals are the basic unit for transferring and preserving knowledge, which is the main issue to be explored by the 4th dilemma.

The question on how to draw out and use the individual's acquired knowledge, transferring it to practice is one of main goals of the 5th dilemma of this research. We assume that the sharing knowledge process occurs in each interaction and learning process, making explicit the knowledge and skill that have already been acquired by an individual and imprinted within his behaviour.

2.3.1 Organisational Innovation – The concept

The innovation theory literature gives the idea that innovations occur mostly within national system of innovation (Freeman 1987; Lundvall 1992; Nelson 1993; Edquist 1997). However, another perspective was studied by organisational studies on innovation and innovation in organisational microsystems (Van de Ven 1986; Aldrich and Fiol 1994; Van de Ven et. al. 1999; den Hertog and Huizenga 2000).

Literature shows that the concept of innovation is very complex, which makes it difficult to arrive to a single definition. The Green Book on Innovation from the European Commission, 1996 defines Innovation as "the successful production, assimilation and exploration of something new". More recently, Mulgan and Albury (2003) made their contribution to the concept pointing out the importance of the innovation implementation results: "new processes, products, services and methods of delivery

which result in significant improvements in outcomes efficiency, effectiveness or quality".

Leadbeater (2003) exposes the complexity of the concept including the interactive and social dimensions: he refers that "the process of innovation is lengthy, interactive and social; many people with different talents, skills and resources have to come together".

On the other hand, the literature assumes various categorisations of innovation. OECD (2002) structures the concept around three areas: the renewal and broadening of the range of products and services and of associated markets; the creation of production, procurement and distribution methods; and the introduction of changes to management, work organisation and workers' qualifications.

Baker's typology (2002) also differentiates three types of innovation: Process; product/service; and strategy/business concept innovation.

To the Process innovation (i.e. work organisation, new internal procedures, policies and organisational forms) and the Strategies and new Business models (i.e. new missions, objectives and strategies) we can call them organisational innovation.

Following the OECD (2002), organisational innovation includes three broad streams: 1) the restructuring of production and efficiency processes, which include business re-engineering, downsizing, flexible work arrangements, outsourcing, greater integration among functional lines, and decentralization; 2) human resource management (HRM) practices, which include performance-based pay, flexible job design and employee involvement, improving employees' skills, and institutional structures affecting the labour management relations; and 3) product/service quality-related practices emphasizing total quality management (TQM) and improving coordination with customers/suppliers.

Table 2 – Types of Organisational Innovation

Production and efficiency practices	Human resources management practices	Product/service quality
• Business re-engineering • Downsizing • Flexible work • Outsourcing • Greater integration among functional areas • Decrease degree of centralization	• Performance-based pay • Flexible job design and employee involvement • Developing skills • Labour-management cooperation	• Total quality management (TQM) • Improving coordination with customers/suppliers • Improving customer satisfaction

Source: Wulong Gu and Surendra Gera (2004). *The Effect of Organisational Innovation and Information Technology on Firm Performance.* Statistics Canada, Catalogue No. 11-622-MIE No. 007

2.3.2 Organisational Innovation and Change Framework

a. Organisational Innovation and Change

A relevant number of those who developed research in organisational innovation have great difficulties tracing borders between this and organisational change. Carrier and Garand (1996) argue the fact that it is not possible to innovate without changing, but it is possible to introduce an organisational change that cannot be considered an innovation. In addition, they consider that change can constitute an innovation in a specific company and, eventually, not in another one. Carrier and Garand mention the existence of four theoretical perspectives on the thematic of innovation and change:

a) A first perspective describes innovation as a change, understood as new, for who adopts (organisation or individuals). This perspective tends to characterize a novelty as innovation (depends on the perception of who adopts - Knight, 1987; Zaltman et al., 1973; Deltour, 2000).

b) One second perspective circumscribes the degree of novelty of a change to the involvement of one given organisation (Becker and Whisler, 1967). In this perspective, an organisation only can be considered innovator if it is the one that adopts the innovation immediately at its occurrence. The newness is not related with the individual position of who adopts the novelty (subjectivity), but of the context where it appears (objectivity).

c) One third perspective becomes related with radical or incremental innovation. Some authors consider that this differentiation is pertinent because it implies different degrees of change and distinct organisational implications. For example, Burgelman and Sayles (1986) defend that the innovation is always radical; otherwise, it constitutes an organisational change. Finally, other theoreticians (Carrier e Garand, 1996) consider that the concept of innovation cannot be characterized as radical because it is out of the reality, which means that the majority of the innovations observed are innovations of routine.

d) One fourth perspective differentiates change and innovation based on the nature and amplitude of the change. In this optics, innovation is restricted to a change. In this perspective, change implies transformation of the structure, process of production and work organisation (Delbecq and Mills, 1985). It will have an effect on organisational *performance*, measured by the increase of the global productivity. It will consider the

new requirements of the market and the linking to new markets (Gasse and Carrier, 1992).

Assuming the idea that organisational innovation leads inevitably to a set of changes in the organisation, it matters to analyse the quarrel that has occurred on the thematic of organisational change. This is presented in a vast literature developed by some of the main schools of thought – i.e., Beer and Nohria (2000); Pettigrew et al (2001); Rajagopalan & Spreitzer (1996); Van de Ven and Pool (1995).

Lewin (in Weick, 1999) conceived one of the most important models on change processes. They present the change as passing through three phases: *unfreeze-change-refreeze*. To make a change, the companies would have to *defrost* themselves of their relative balance and then change; after that, the implemented changes would be *refrozen* and perpetuated.

However, what happens is that many times these changes lead companies to abandon their previous format in order to assume another one completely different. The traditional model presents some problems related to what has happened in the last decades that have been characterized by continuous and very fast movements of change.

Weick and Quinn (1999) had conceived a dual typology that presents change as: a) episodic, discontinuous and intermittent or, in another perspective, change can be b) continuous and incremental. Although some authors refer this is a very simple way to analyse the change, Poole and Van de Ven (1995; 2004), for instance, argue that the change process is related to a progression of events in an organisation.

Other researchers (Orlikowski, 1996; Colville, Dalton and Tomkins, 1993) argue that the adjustments that are occurring in an organisation are the essence of the organisational change and, even if they are small, they have the power to modify the strategy and the structure of the organisation.

In this context, we can say that given the continuity of change, it does not make sense to carry through a deliberate intervention to initiate a process of change, like the traditional model of Lewin state, translating the idea that the change is made of deliberated form, programmed and carried through *top-down* (Beer and Nohria, 2001).

Other perspectives are associated to the idea that change will have to be a process of construction that already exists inside the organisation. Weick and Quinn (1999) argue that "the change doesn't start because it never stops".

In their more recent inquiries, Tsoukas and Chia (2002) also state that the change is the norm, in opposition to the more traditional perspectives dominated by the assumption of the stability, being the change the exception. For Tsoukas and Chia: "change is always potentially there, if only we care to look for it" (2002: 568).

Analysing change in the context of process theory, Van de Ven and Poole (1995), had identified four theories that describe the types of existing processes of change: cycle of life, teleological, dialectic and evolutionary.

The theory of the process life cycle includes a large number of theories of human development and organisation (Greiner, 1972; Kimberly, Miles, 1980), taking decisions in group (Gersick, 1988), and the development of a new company (Burgelman, Sayles, 1986). The theory of the life cycle assumes that the change is imminent, which means that the organisation contains a logic that regulates this process. Elements of the external environment act as mediating forces in the process of change (Van de Ven and Poole, 1995).

The teleological theory of the process is compatible with theories such as: bureaucracy (Merton, 1970), the process of decision making (March, Simon, 1958), epigenesis (Etzioni, 1963), voluntarism (Parsons, 1956), adaptative knowledge (March, Olsen, 1976) and many models of planning (Lorange, 1980). This is based on the assumption that the development of organisations is planned and adapted.

The dialectic theory assumes that the organisations' development exists in a world with a diversity of events, with colliding contradictory forces or values that compete between each other for domination and control. Greiner (1972) showed that the tensions between evolutionary and revolutionary forces have the organisational propensity to stop the growth. The change occurs through the opposition of values, forces or events.

The theory of the evolution estimates that the change occurs: a) in a process (new organisational forms are created as a result of change - Aldrich, 1979); b) by selection (it occurs mainly when competition exists and, therefore, the environment selects the best forms to be successful in one definitive environment - Hannan, Freeman, 1977); and c) by retention (involving forces that perpetuate and keep definitive organisational

forms). Weick (1979) and Pfeffer (1982) observe that the variation stimulates the selection of new organisational forms.

However, the practice associated to theory has lead to the statement that the isolated models cannot be used to analyse changes in a global way. Van de Ven and Poole argued that is necessary for a combination of different types of theories in order to understand all involved in the process of change.

Another very important aspect, disclosed by Tsoukas and Chia, is that if we only look at change as one formal organisational change process, we could not investigate the micro changes that occur in continuum in organisations. These can only be studied from a consistent way if we consider that all organisational actors participate actively in the process. This change involves a constant analysis of the habits, beliefs and values that condition the way changes and new experiences are accepted through interactions and dialogue (Tsoukas and Chia, 2002).

The small changes are normally not a concern for the organisations' top management. However, it's clear that organisations' Managers have the power to initiate a formal change process, but they should take into consideration the micro changes that are considered by several authors (Kotter, 1995; Beer and Nohria, 2000) as the main explanation for about 70% of failure in the processes of change.

Authors like Beer and Eisentat (2000) and Beer and Nhoria (2000) argue that a process of organisational change is possible to plan, control and manage like any another organisational process. This premise is reviewed in the model of Lewin that doe not consider the effect of the external environment during the process of *unfreezing* and *refreezing* (Styhre, 2002).

The contingency theory (Lawrence and Lorsh, 1967; Katz and Kahn, 1996; Thompson, 1967), the theory of the evolution (Nelson and Winter, 1982, Aldrich, 1999) and the institutional theory (Dimaggio and Powell, 1991; Scott, 1995), are some of the theoretical perspectives on organisations that make the correspondence between the internal aspects of the organisation itself and the external context.

Already in 1985, Pettigrew criticized existing literature on the organisational change, considering it contextual, historical and processual. Since then some advances have occurred and, as previously referred, there are several authors that argue the fact that the context and the share cannot be separated.

The dynamic of the organisational change is far from complete understanding, namely the effect of time, processes, discontinuities and context. According to Pettigrew et al. (2000), in a dynamic and international complex world the search for a change standard requires a higher focus on the context.

Contemporary researchers considerer organisational change as a continuous phenomena and, in some activity sectors, companies face long periods of turbulence, followed by short and rare periods of relative stability and, therefore, several models have been conceived by researchers with the goal to decode the change process. However, Van de Ven and Poole defend a combination of different types of theories so that it is possible to understand every element involved in the change process.

When analyzing the nature of change, we can find several authors that identify different kinds of change:

a) Radical change *versus* Incremental change:

   The changes can be of incremental or radical nature. However, for some authors only the radical change makes sense (Hamel e Prahalad, 1994), while for others, only the incremental change makes sense (Imai, 1989).

   Radical changes aim at modifying the whole dynamics of the processes and the interactions in the companies. The incremental change aims at continuous improvements in the processes, technologies and in the existing competencies.

   As we will see in the field research (chapter 5), both organisations are always implementing incremental changes, specially BOSCH TERMOTECNOLOGIA SA in the organisation area.

b) Planned change *versus* Not Planned change:

   The organisational change can be a planned process, guided by the management, as a path to lead the organisation from a less favourable situation to a more favourable one. This perspective has a teleological base, where the change is the responsibility of top management. The models of planned management use three main phases: preparation, implementation and reinforcement of change.

   The change can also be an emergent and complex process, whose contours are going to be defined in the daily work through the organisation whenever workers are looking for a better way to answer the challenges faced by the organisation. The emergent or not planned change results from the interactions in the system and not because of the will of top management.

The not planned change is normally an answer to local problems (in an operational plan) and provides immediate feedback to the ones that are involved, facilitating and promoting the learning process.

The next table shows a set of examples of change processes according to the scope and the source of change:

Table 3 - Nature of Change

Scope		Source of change	
Radical change	**Incremental change**	**Not Planned change**	**Planned change**
Is intense and involves all.	It is continuous and incremental and the impact is minor.	They occur in everyday work.	It has specific goals.
For example: the arrival of a new president to the company, because of a merger and acquisitions action or because of low operational results.	*For example:* the introduction of new systems and processes.	*For example:* a problem of relationship between departments.	*For example:* continuous improvement.
The success depends, in part, of the change agents. They assume the responsibility to change existing standards.	The success depends, in part, of the change agents. They assume the responsibility to change existing standards.	The adequate goal is to act quickly to minimize the negative consequences and to maximize the possible benefits.	It requires permanent attention to detect problems and opportunities. It requires also the involvement of all actors.

Source: diverse authors

b. Origins of Organisational Innovation and Change

Deltour (2000) explains that the innovation sources are associated with a new product, a new idea or new practices. A possible classification of the sources consists of differentiating internal sources and external sources.

Dantas (2001) considers the internal structure of R&D and the strategy of an organisation as internal sources of innovation. The external sources are the customers,

suppliers, deliverers, the competitors and the universities/research centres. Kovács (2002) mentions other factors without distinguishing the type of sources: Inter-organisational relations (strategically cooperation, alliances, etc.), professionals associations, consultancy companies, equipment supplying companies, management specialists and the publicity made by the media. Fonseca says that innovation can have different origins: "(...) from conferences people have attended, magazines, from analogies drawn from to other social settings, from social practices" (2000:91).

In this context, we can consider that external sources are based on all the events and activities made outside the company, either in the national or international scope. Internal sources are associated to all elements and activities that are part of company - technical, cultural or intellectual capacities.

According to Fombrun (1984) in Caetano and Tavares (2000), factors like technology, economics, culture and politics have had a very important influence in organisational changes.

Table 4 - Main changes in the organisational context

Factors	**Changes**
Technological	Increase of innovation in products / services; New technologies intended for production and information.
Economic	Increase of the global competition; Scarcity of resources; Explosion of services in the industrialized countries.
Social	Changes in the market structure (increase of education levels and workers' professionalization); Major importance given to product and service quality; Change in people's values and behaviour regarding work.
Political	Tension between the public and the private sector about activities' regulation; Creation of conditions to establish partnership, alliances and cooperation processes.

Source: Caetano e Tavares, 2000

c. Facilitators of Organisational Innovation and Change

Innovation is a very complex process that led people and organisations to distinguish behaviours that can either facilitate or make changes difficult. To facilitate the process

we can find in the literature several factors related to individuals (Ross et al. 2004) like motivation and challenges brought by the innovation process. The recognition of the importance of the employee's involvement and participation can also be one of the facilitators.

Other facilitators are creativity, the possibility of learning and development and the increase of skills and competencies.

On the other side, we can find some factors related to the organisation itself like:

- the organisational and business context;
- the establishment and promotion of an "innovation culture", considering aspects such as tolerance, acceptance to risk and empowerment (Lynch, 1999; Glor, 1997);
- management's support of innovation (Lyonnais & Houle-Rutherford, 1996; Beukman & Hartfield, 1998);

Borins (2001) conducted a wide scale inquiry, having identified a set of facilitators:

- Management support to an innovation culture that encourages experimentation;
- Establishment of an open dialogue that supports new ideas;
- The encouragement of new forms of thinking within the organisation;
- Active research of information produced outside the organisation with the main goal of benchmarking, and to visit professional sites and nets;
- Expectation of the people to innovate to all the levels of organisation;
- Support to experimentation, recognizing that imperfections can occur but that it is possible to learn from the errors made.

a) Dialogue

According to several researchers (for example, Isaacs 1994, Gustavsen 1992, Nonaka 1995, Senge 1990, 1996, Schein 1993, 1996), dialogue assume a big importance in organisational development and it can be one of the most important facilitator in an organisational innovation and change process.

Organisational dialogue is a process that helps create agreements between the organisational actors, contributing for a higher identification with the organisation.

Some authors emphasize the value of dialogue, especially in the theories of the organisational learning and in knowledge management theories.

According to Schein (1993, p. 51), "cultural learning across boundaries cannot be created or sustained without initial and periodic dialogues. This dialogue involves going beyond the cultural status quo". Later he refers that," Dialogues, then, is at the root of all effective group action."

Peter Senge (1990) refers in the book "The Fifth Discipline" (p. 11-12) to an inquiry carried out for Diane McGinty Weston that presents as results three elements related with efforts of organisational learning: 1) vision, values and integrity; 2) dialogue; and 3) thought systems.

Nonaka (1995) refers that dialogue can transform the tacit knowledge into explicit knowledge. The most important in an organisation is to create knowledge, which happens in the interaction process between tacit and explicit knowledge.

This author also refers that "we have pointed out; knowledge is created only by individuals. An organisation cannot create knowledge on its own without individuals. It is, therefore, very important will be the organisation you support and stimulate the knowledge-creating activities of individuals or provide the appropriate contexts to facilitate knowledge creation. Organisational knowledge creation should be understood as the process that "organisationally" amplifies the knowledge created by individuals and crystallizes it at the group level through dialogues, discussion, experience sharing, or observation." Nonaka & Takeuchi, (1995, p. 239)

Isaacs (1994) refers that the dialogue is one innovative alternative to carry through joint shares between the individuals.

Tuomi (1999) concludes in the study carried out on the organisational knowledge that in informal meetings people communicate freely, without hierarchic barriers.

Dixon and Schein emphasize the following ideas:

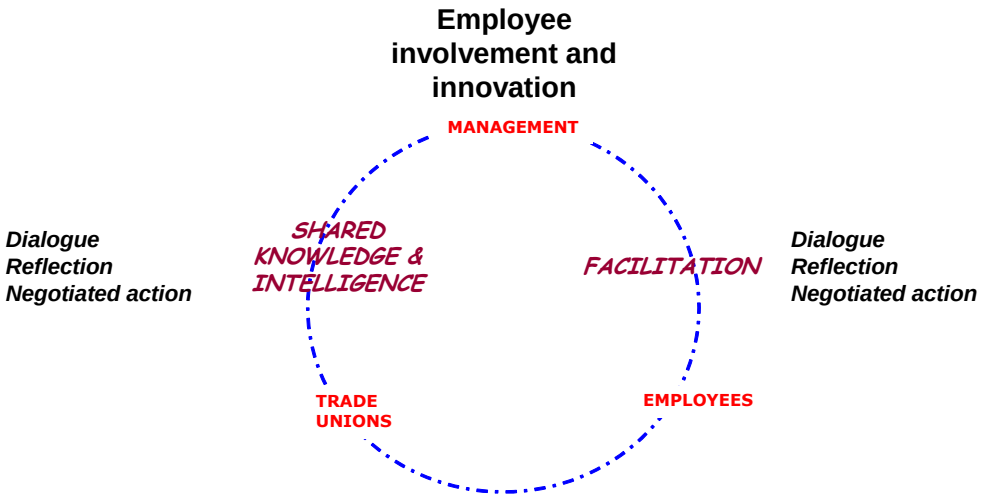
- Organisations need collective meanings.
- Collective meaning is built by the members of the organisation through dialogue.
- Collective meaning can also be communicated to others, but in the tacit process, meanings can be disclosed (Dixon 1997, p. 24).

The dialogue is a space where individuals can make explicit their opinions and points of view, and create shared opinions with the same meaning.

This leads us to the power of interactions between organisational actors as we point out in the 4th dilemma (p.16), when talking about the roles and responsibilities of top management, Middle Managers, Technicians, Operators and even external actors like consultants, universities and other institutions of inquiry; public institutions and social actors.

In the next figure, Totterdill (2002) shows us the relationship between the most important actors in the field, underlining the importance of knowledge sharing in organisational processes.

Figure 2 – Knowledge Sharing Arena



Source: Totterdill, P. (2002)

d. Obstacles to Organisational Innovation and Change

When we think about innovation and change, we always refer to people being suspicious and resistant to change as their usual attitude. Therefore, we can also identify a tendency in those individuals to make everything in the usual way - the uncertainty of change reveals feelings like unreliability and fear of failure due to lack of competencies, all of which could leave to loss of power.

Sometimes these feelings emerge due to lack of involvement in the change process or because of the absence of information concerning how the change will affect the content of their functions or even because of the absence of their participation in the definition of change goals.

Kovács (2002) defines a set of factors that can represent a resistance to organisational innovation:

- Organisational structures that tend to stability and inertia;
- Individuals and groups that feel threatened (about their professional situation, the content of their work, income, prestige, and instituted power) and, therefore, resist to innovation;
- Organisational culture defined by 'bureaucratic' values and tending to the polarization (absence of shared values associated to an environment where there is little information and communication between workers and the administration);
- Human resources management mainly based in quantitative flexibility (reduction of the number of cash and change of the employee contract - permanent or temporary);
- Lack of participation and information about the introduction of the changes;
- Nature of the labour relations not based on the dialogue and negotiation between the social partners.

Dantas (2001) analyses other factors that will be able to represent obstacles to the innovation: dimension of the organisation, its resources (human, technological and financial) and the company's culture.

Neely and Hii (1998) consider the distinction between internal and external barriers to the organisation. In the internal barriers, they include the rigidity, hierarchic structures of communication and organisational deeds of division, lack of vision, resistance to the change, lack of motivation and attitudes of resistance to the risk. In the external barriers they include infrastructure lack, scarce education and training systems, legislative barriers and failure applying the existing competencies.

In the internal barriers, we can consider the dimension of the organisation and the organisational culture.

On the influence of the company's dimension in the innovation process, much has been written with theoretical divergent positions. For Rothwell (cf. Dantas), we can't assure advantages as a consequence of the changeable dimension because if larger companies have advantages in terms of resources (financial, capacity to attract and to keep qualified workers), the smaller companies have a set of characteristics that permit answering the requirements of the innovation process. About these characteristics,

Rothwell and Zegveld (cf. Dantas) mention that the communication can become much easier by allowing the involvement of workers from distinct areas; that the simple the structure, the more flexible it will be and, finally, management should take risks more easily.

About organisational culture, Dantas reports that "the innovative culture (...) it cannot be imposed by the top management through internal communications; it will be the result of the influence of the top management, materialized through the coherence of its behaviour, its shares" (2001:113). Dantas defends that a change from a conservative culture into a culture guided towards innovation (as expressed in the 2nd dilemma, p. 14), implies:

- Enhancing people's role by involving them in the definition of strategies and the establishment of goals; by creating a communication system; by promoting the permanent improvement of work conditions and the constant evaluation of workers;
- Stimulating creativity;
- Assuming a perspective of medium/long period goals, instead of a perspective of short-term goals in order to obtain immediate profit;
- Promoting flexible structures that will allow an increase of informality, communication, and the participation of all members of the organisation.

The work by the Competitiveness Advisory Group and the OECD has identified a range of possible obstacles. These include:

a) *Awareness*. Managers, trade unions, and employees must be aware of "high performance work practices", their costs and their benefits. However, some Managers lack information about them. Moreover, many are unaware of the need to 'bundle' such practices together as part of a high-performance work system that supports an overall business strategy.

b) *Attitudes*. Managers, employees and their representatives must have positive attitudes towards the introduction of new forms of work organisation. However, some people are resistant to change and try to defend existing practices and arrangements partly because of uncertainty as to what the future holds.

c) *Practical Problems*. There are a number of practical problems associated with the introduction of new “high-performance work systems”. It takes a long time, requires systemic change, and demands a major investment of resources.

d) *Capacity to Implement Change*. Successful implementation requires a major commitment of managerial resources. It also requires the financial strength to absorb the costs of any disruption to operations whilst new organisational methods are being implemented. Many companies, particularly SMEs, do not have the financial or managerial resources to implement change successfully.

e) *Investor Pressure*. Investors are amongst the strongest drivers of managerial performance, but they have little knowledge about the costs and benefits of organisational innovation. This makes it difficult for investors to value companies properly and may lead to the misallocation of resources within capital markets. It also makes it difficult for investors to place pressure on Managers to introduce new organisational strategies.

f) *Business Economics*. For rational economic reasons it can be difficult to justify investment in organisational innovation. This may be because the costs can be high, the total scale of cost can be uncertain, and the benefits can be difficult to quantify and take many years to accrue.

g) *Framework Conditions*. It is important that the institutional settings within which organisational changes take place is supportive. Areas of concern include:

- Rigidity in product markets that limit the exposure of Managers to competitive pressure or inhibit companies’ ability to work collaboratively within “supply chains”.

- Weaknes in corporate governance (such as state ownership of shares or ‘cross-holdings’ of shares) that lessens the pressures that capital markets place on Managers.

- Rigidity in the labour market, particularly in areas such as remuneration, contracts, and working time.

Making the analysis a little more wide, Totterdill (2002) refers that there is an extensive body of research suggesting that the spread of successful organisational innovation in these arenas remains weak in Europe. This can be explained by a number of mutually reinforcing factors that include:

- Low levels of awareness of innovative practices and its benefits amongst Managers, social partners and business support organisations;
- Poor access to evidence-based methods and resources capable of supporting organisational learning and innovation;
- Countervailing trends in the design and application of new technologies;
- Limited distribution of the competencies associated with new forms of work organisation within the workforce.

e. Possible Impacts of Organisational Innovation and Change

Many impacts can emerge because of organisational innovation and change.

According to Duffee (1986) and Williamson (1990), it may create: new role demands (underload or overload); role ambiguity (lack of leadership, goals, and well-defined job descriptions); or role conflict. As part of the transition, new policies and procedures are likely to be implemented. The new work environment may be different from the old one; supervisors may have different expectations for workers' performance. Staff may not be adequately prepared for innovation and change because they have not been given sufficient training. Supervisors may fail to provide staff with needed support prior to, during, and after the implementation process.

Conflicts with Middle Managers and co-workers may occur. In general, the overall organisational climate may not be conducive to change, which may create resistance. This, in turn, makes it likely that the implementation of new management practices will be difficult or may even fail.

New roles may initially be stressful and can affect performance, with an increase of employee's health problems, lower job satisfaction, increase anxiety, absenteeism, and job turnover. The introduction of new policies and procedures need time for employees to become familiar with them.

The work environment is likely to include new technological equipment that may be unfamiliar to the employees. Managers will expect to use new management practices to accomplish tasks. However, they may never have been provided with management training.

There are some impacts that result from the organisational changes implementation:

Table 5 - Impacts of the Organisational Innovation and Change

Organisational	Structure of the organisation Organisation of the work Working time Organisational culture
Aspects introduced for the market	Market orientation New products/services Investment in core capabilities Internationalization Quality
Aspects involving people	Communication / Involvement Rewards and recognition Training and skills' development New work practices Teamwork
Technological	Introduction of new technologies
Company	Investment in innovation Entrepreneurship Cooperation relations

Source: Wille, 1989 in Stacey, 1998 (adapted)

2.4 Empirical Evidences on Innovation and Organisational Change

This part of the research intends to explore the main empirical evidences about organisational innovation. A literature analysis was carried through on projects/programmes/research of organisational innovation and change.

Since the decade of 90, some research on organisational innovation has been carried out, especially in the Nordic countries of Europe. The results of these researches point out the type of implemented innovations, changes decurrently and the effect on the performance of the organisations.

An inquiry carried out in 1900 on organisations in Denmark (Lund & Gjerding, 1996) disclose that organisations with higher degree of flexibility combine organisational innovation with technological innovation, implementing new forms of work organisation such as delegation of responsibilities, vertical and horizontal integration and development of human resources. Also, they present a bigger propensity for the creation of networks of external partnerships.

Another research on organisational change was done in a thousand of Swedish companies (Gustaven et al, 1993), showing a positive relation between the change and the increase of productivity. The same trend is confirmed through the EPOC Survey (1997) on 6000 European companies, confirming the direct participation of the workers and that some forms of work have positive impacts in the productivity and quality of organisations.

In Portugal, an excellent case was the LAIO program (Line of Support of Organisational Innovation), a pilot project who promoted the organisational innovation in the following areas: work organisation, human resources management, corporate social responsibility, hygiene and security at work, participation and social dialogue, work time management and solutions that lead to continuous training.

A questionnaire was carried through the participant companies with the goal to evaluate the impact and the results generated with the implementation of the organisational innovations (Gomes et al., 2002).

For most of participant companies, the investment on organisational innovation contributed for the development of the workers competencies, especially through the creation of a level of middle management and in the delegation of responsibilities. Also, their participation changes and the improvement of environmental conditions in the content of the work lead to higher levels of work satisfaction.

Relatively to new forms of work organisation, some companies had implemented teamwork, leading the changes in the structure and in the culture of the organisation. Related factors were also pointed out, like a higher internal communication, an increased autonomy in work and the decentralization of the decision-making.

Other important impacts that they have mention are the reduction of costs related to bad quality products and services, the reduction of production times and also a stronger proximity to their external partners (customers, suppliers) and increase of their contributions with the goal to improve product and services' quality.

However, most empirical evidences refer to the analysis of case studies in a specific organisation on specific aspects related with organisational innovation.

Some of these examples can be found in the document "New forms of work organisation and productivity", a study prepared by Business Decisions Limited for the DGV of the European Commission.

The study identifies seven main areas in which changes are being introduced by leading companies:

a) New organisational structures focused on process-based, market orientated, teamwork, and flatten, decentralised structures with more empowerment and devolved responsibilities.

b) New business practices, including continuous improvement, outsourcing, supplier and customer partnerships, and quality management.

c) Increased investment on education and training throughout the organisation in order to improve job skills, and to introduce wider management-type skills such as problem-solving, group working and learning skills.

d) New corporate cultures, including greater trust, increased participation, greater personal autonomy, better alignment of employee and business objectives, increased consultation, and greater focus on the customer and quality.

e) New, more flexible and less hierarchical working methods, including more flexible working time, working patterns, job groups and job content, multiskilling, increase of part-time workers and new management models based on coaching and supporting.

f) New performance measurement techniques shared throughout the company and designed to focus both employees and Managers on the long-term drive for competitive success as well as traditional financial results.

g) New reward systems, including payments for knowledge, team and individual performance bonuses, profit-sharing schemes, and share ownership programmes.

Some quantified data can also be a testimony of some evidences of organisational innovation implementation.

Evidences from studies in Sweden, Denmark, Finland, Germany, and the USA, suggest that “high performance work practices” and new forms of work organisation are most likely to be found in companies that are larger (employ more than 500 people), exposed to international competition, and involved in manufacturing.

Case study evidences show that new forms of work organisation are used by companies in service sectors such as financial services and mail order retailing;

manufacturing industries such as chemicals and plastic components; and primary extraction such as peat production.

The survey of German manufacturers of investment goods also found that employment growth was greater with companies pursuing strategies based on differentiation (through quality, service, variety, or innovation) introduced new working practices.

Many companies in Europe, the USA, and Canada have had some experience with one or more forms of “high performance work practice” but very few companies make extensive use of such practices.

Evidence about the overall penetration of “high performance work systems” in Europe is poor. The best European studies have been carried out in Finland, Sweden, and Denmark. Using a common definition of a “flexible organisation” that takes into account employee development and task delegation, these studies estimate that 15% to 25% of Nordic workplaces can be defined as “flexible”.

These studies also demonstrate a link between the ‘flexibility’ of a workplace and the adoption of other modern work practices such as Total Quality Management and remuneration systems that incorporate skills, knowledge, and group performance. By comparison, the most authoritative US study suggests that 37% of US manufacturing companies make extensive use of two or more high-performance work practices.

2.5 Knowledge Framework

2.5.1 Conceptualizing Knowledge

Knowledge as been studied by different schools of thought: Organisational Theory, Industrial Economy, Management, Innovation Management. All of them, as analysed in the form, result and are processed throughout organisations’ learning system.

The aim of this research is to analyse the role of individual knowledge in organisational innovation and change processes, and in the literature we can find a strong link between them. However, knowledge can be an enabler or a disabler of organisational innovation and change success because individual knowledge transfer and use is a very complex social interaction process (McAdam and McCreedy 1999; Nonaka, Toyama et al. 2000; Von-Krogh, Ichijo et al. 2000).

To Davenport and Prusak (2000) “knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information”.

Other reference authors like Polanyi (1958) associate knowledge to action. He says that “knowledge is the ability to act”. Nonaka and Takeuchi (1997) explain that knowledge is created by the flow of information associated with the beliefs and commitment of those who possess it.

In the view of Nonaka and Takeuchi (1997), knowledge is created within the company to make it more successful, to keep it on the market, to increase competitiveness and to keep it ahead of its rivals.

Coulson Thomas (2002) remarks that today's organisations do not compete in terms of products, services or technology but in terms of know-how, processes and values.

2.5.2 Individual Knowledge and Group Knowledge

Tacit knowledge is seen as a property of individuals. However, research has made it clear that a team of interacting individuals can have knowledge that transcends the knowledge of each of them individually (Walsh 1995). According to Buckingham Shum (1997), organisational knowledge is multidisciplinary, hard to formalise, and generated in discussions with competing viewpoints. This third categorisation of organisational knowledge is an attempt to recognise this understanding of knowledge and incorporate both individual and group knowledge.

Walsh (1995) uses the term Knowledge Structure to describe a "mental template" that is used to give a complex information environment form and meaning. Knowledge structures are built on past experiences and are used to store data to allow subsequent interpretation and action. Hence, individual knowledge is concerned with personal knowledge structures, while group knowledge is related to organisational knowledge structures.

We can define group knowledge as the knowledge and skills acquired collectively by individuals who have been exposed to similar job-related situations (Reuber et al. 1990).

For example, organisational groups have part of their knowledge codified in a form of workflow (or group) ‘metaphors’ that only the members of that group can understand.

These workflow metaphors are typically resulting of systematic communication practices that occur in the workgroup environment.

Related to knowledge another concept has emerged: Armstrong (2001) has studied the concept of intellectual capital as "the stocks and flows of knowledge available to an organisation". For this researcher, intellectual capital represents, therefore, a frame for three main elements:

- The Human Capital, which represents the creative force of every organisation in terms of skills, competencies and knowledge.
- The Social Capital, representing the relationships inside and outside the organisation which enhance the human capital potential.
- The Organisational Capital (seen as materials, databases, manuals), which is owned by the organisation itself (and not the employees as individuals).

The human and the social capital are still dealt with in an unsatisfactory way in most organisations. The existence of learning groups, the development of knowledge networks or communities of practice is still exceptions in few organisations.

2.5.3 Tacit and explicit knowledge

Tacit knowledge is contextual, held informally, and gained through experience and interactions among individuals and between individuals and processes (Nidumolu, 2001; Fahey & Prusak, 1998). It is rooted in the actions, experience, the involvement of organisational members in a specific context, and encompasses both cognitive and technical knowledge dimensions (Nonaka, 1994). Cognitive tacit knowledge is defined as a set of mental models that influence an individual's actions and decisions. An example of this would be a salesperson's beliefs about what might appeal to a customer (Alavi & Leidner, 2001). However, knowing what might appeal is not sufficient to enable that person to make the sale. The technical dimension of tacit knowledge is defined as the know-how that is applicable to a specific situation (Nonaka, 1994).

For example, once the customer is interested, a salesperson needs to have the sales skills to lead the customer to actually buy the product. These skills are acquired through experience and the salespersons' involvement with the customer, the products, and the organisation. The two dimensions together make up the salespersons' tacit knowledge about the best way to approach a specific customer. This is different from

explicit knowledge that might include the salespersons' knowledge about specific product functionality and costs.

What we have seen in this example is a particular way of developing a process of sales, using tacit knowledge as expressed in the 1st dilemma (p. 13). To make a better performance and make the sale, the salesperson probably needs to associate both tacit and explicit knowledge, for example, to explain the product's functionalities using his own ability to do it.

The knowledge-based perspective of organisations implies that the combination of resources a firm uses to offer its products/services is a function of the firm's knowledge (Alavi & Leidner, 2001). This perspective raises the issue of the best way to manage the knowledge resource, including how to facilitate knowledge sharing behaviours. This requires a view of knowledge that is broader than the traditional view of knowledge as an object that can be codified and distributed outside of the individual who created it (Fahey & Prusak, 1998). This type of knowledge is often referred to as explicit knowledge (Nonaka, 1994). In the last decade, many firms have begun to realize the importance of the storehouse of knowledge that exists within the heads and experiences of their organisational members, while simultaneously grasping that it is difficult to separate from the originating individual (Grant, 1996). This suggests that knowledge may also be viewed as being embedded into the practices and communications of individuals (Fahey & Prusak, 1998; Spender, 1996; Swap, Leonard, Shields, & Abrams, 2001), and is often associated with tacit knowledge. The embedding may arise out of experiences of the individuals or the workgroups to which they belong to, as well as from interpretations and routinization of work practices (Alavi & Leidner, 2000).

The effective utilisation of tacit knowledge is essential for competitiveness, but the problem is that the tacit knowledge is difficult to capture, even if we all acknowledge that tacit knowledge is embedded in organisation practices and in the people of an organisation.

According to Frappaolo and Wilson Todd (2000), tacit knowledge is highly personalized, context sensitive and informal, and very hard to measure and manage. It includes know-how, intuition and informal communications that make up a large part of the organisation's culture.

Across industries during 1998 and 1999 there was a clear perception that the tacit knowledge base could account for the majority of an organisation's collective knowledge. A survey carried out by Delphi Group [1]in 1999 asked companies, "What is the primary repository for knowledge within the organisation?" The responses received suggested that, on average, 42% of the corporate knowledge was within the minds of employees (Frappaolo and Wilson Todd, 2000).

Analysing this context, we can say that organisations face the problem of creating an infrastructure where tacit knowledge can be made accessible.

Organisations have begun to establish a common strategic goal to manage knowledge, to develop a knowledge cycle and make knowledge available company-wide - but the link with tacit knowledge remains elusive. Despite the importance of tacit knowledge, initially companies have focused upon developing an explicit knowledge base. During the year 1999 Frappaolo and Wilson Todd asked a group of companies to identify the primary benefits of implementing knowledge management (Frappaolo and Wilson Todd, 2000). The responses were:

- providing an enhanced way to organise existing corporate knowledge;
- making individuals more effective at sharing explicit knowledge;
- new ways to expose tacit knowledge.

Even if organisations are trying to arrange other ways to use tacit knowledge, when knowledge is explicit it is easier to identify, it is formal and systematic and can be more easily gathered, measured and stored. Found in reports, manuals and documents, it is the basis of paper and electronic documentation and knowledge bases and technology can more readily be applied to enhance its value and make it more accessible.

Initially organisations used groupware applications to collect, store and share their explicit knowledge. Once a strong knowledge base has reached a certain level of efficiency, businesses have begun to implement collaborative technology using intranet, Internet and extranet, e-mail, video conferencing and tele-conferencing to assist in the growth of tacit knowledge transfer.

Organisations have to create structures that enable them to transform tacit knowledge into explicit knowledge and make knowledge available and accessible organisation-wide.

[1] The Delphi Group Brings Knowledge Management Practices & Methodologies Classes to Mid-West Organisations, August 3-5 1999

2.5.4 Knowledge Use and Share

Knowledge produced and carried by individuals only reaches its full potential to create economic value when it is embodied in organisational routines, that is, when it has been converted into organisational knowledge.

To share knowledge organisations have a tendency to invest in information technology rather than in developing social relationships, and not many have attempted the cultural and organisational transformation needed to promote knowledge transmission and circulation.

The use of employee's tacit knowledge to reorganize work routines and embed their knowledge into new products and services can lead to sustained competitive advantage. However, this kind of knowledge is carried in the heads of individuals and the dilemma is how it can be embedded in organisational routines to fully maximize its utility.

Information technology is part of the essential infrastructure of knowledge sharing, but it is not sufficient because knowledge involves thinking, an activity that only human beings are able to do.

Extensive literature provides several examples of organisations skilful at knowledge share (Zairi & Whymark, 2000), but most of these case studies do not fully explore why these organisations were successful at this endeavour. To fully understand how to grow this capability, it is probably necessary to understand what factors tend to affect knowledge sharing. The literature within the knowledge domain provided the following five factors that might influence knowledge share:

1. Relational channels, frequency and depth of two-way human-to-human contact (Rulke, Zaheer, & Anderson, 2000)
2. Partner similarity, degree of similarity (i.e., interests, background or education) between individuals (Almeida & Kogut, 1999; Darr & Kurtzberg, 2000)
3. Depreciation, loss of knowledge after the share (Argote, Beckman, & Epple, 1990; Darr, Argote, & Epple, 1995)
4. Organisational self-knowledge, what individuals know and use (Rulke, Zaheer, & Anderson, 2000)
5. Divergence of interests and congruency of individual and organisational goals (Alchian & Demsetz, 1972; Jensen & Meckling, 1976; Donaldson, 1990).

Knowledge is assumed by several authors (Drucker, 1988; Nonaka, 1991; Morey & Frangioso, 1997; Zwass, 1999; Argote & Ingram, 2000; Argote, Ingram, Levine, & Moreland, 2000; Davenport & Prusak, 2000; Lahti & Beyerlein, 2000; Rulke, Zaheer & Anderson, 2000) as the organisation's best sustainable source of competitive advantage. Nevertheless, organisations have to really use it to became more innovative and implement successful organisational changes.

2.5.4.1 Knowledge Sharing Mechanisms

Organisation can facilitate knowledge share depending on the form of knowledge transferred by using incentives, and structural and cultural coordination mechanisms. This idea is the main focus of the 4th dilemma (p. 16) and means that it's important that organisations have a set of mechanisms to promote the share of knowledge.

As we shall see later in the field research, according to the opportunities and to each culture and specific products or activities of the organisation, employees always find a way or create their own mechanisms of knowledge share even if the organisation is not aware of it.

On the other hand, Yang and Chen (2007) have studied the association between organisational knowledge capabilities and the knowledge sharing process, using regression analysis with data from questionnaires collected in different industries with a valid response rate of 62.4%. The results show that organisational knowledge capabilities have a positive association with knowledge share. Technical, structural, and human knowledge capabilities are significant for organisational knowledge sharing.

A systematisation of knowledge sharing process is showed below, and we can observe that different kinds of knowledge can be shared in very different ways, according to the goal and the mechanisms existing in the organisation.

Table 6 – Knowledge Sharing Mechanisms

Mode Of Knowledge Transfer	Knowledge Transmission	Experience Exchange	Routinization
• Basic principle	• Selective transmission with low contextual reference	• Continuous exchange of experience within a collectively shared context	• Routinized collaboration within a collectively shared context
Organisation goal	Facilitate knowledge transmission	Enable experience exchange	Establish collective routines
Focal Knowledge	Explicit Knowledge	Explicit and discursive knowledge	Explicit, discursive, and tacit knowledge
Observability and assessment	Explicit knowledge	Participation in knowledge transfer	Operational results
Design recommendations	Development of technical and social infrastructure for knowledge transmission	Development of space for social interaction for experience exchange	Development of basic conditions for routinization
Measures	Social presentations, reports, technical: IT – systems, reports, ...	CoP, Ba, Quality circles, mentoring, exchanging experiences	Temporary or permanent work groups

Source: diverse authors

This table shows that, normally, the basic principles of the organisation are transmitted with low contextual reference, but as a continuous exchange of experience and also with work routines.

The organisation goals are normally easily transmitted, enabling experience exchange and establishing collective routines. Focal knowledge, for instance knowledge about products or services, is transmitted in an explicit way, namely through instruction manuals or other kind of documentation.

Observability and assessment is transmitted as explicit knowledge involving operational results of the organisation's activity. Design recommendation is transmitted through technical and social infrastructure. Finally, measures are transmitted through presentations, reports, IT systems.

On the other hand, the human resources practices existing in the organisation can be a facilitator of knowledge sharing. They can create bases for enabling both the creation of new knowledge (for example, new products' development) as well as the improvement of current practices (for example, client services' improvement), associating monetary and recognition rewards to new ideas and suggestions for all employees.

Nevertheless, a great number of authors claim that many companies suffer from considerable barriers, impeding knowledge sharing and finally reducing organisational efficiency (e.g., Husted & Michailova, 2002).

The typical knowledge sharing barriers identified in the literature can be organized in three groups:

a) Individual barriers, grounded in the participants of the knowledge sharing process, in both the receiving and the transmitting parties. This group includes a wide range of barriers like the fear to lose personal competitive advantage and to be misunderstood and misinterpreted; group thinking; preference to one's own ideas instead of somebody's else, etc. (Husted and Michailova, 2002)

b) Infrastructural (organisational) barriers are determined by the organisational structure, the system of communication and organisational culture (Bock et al, 2005; Hall, 2002). For example, Book et al. note that in order to share knowledge successfully, an organisation must reinforce the value of trust – both among employees as well as between an employee and the organisation – and promote free information flows and tolerance to mistakes.

c) Ontological barriers that deal with the knowledge itself and arising from the tacit knowledge transfer problems (Nonaka, 1991), as well as from perceived value of knowledge (Ford & Staples, 2005), are often not recognized at all by the knowledge sharing participants (Hall, 2002).

2.5.5 Knowledge as Competencies

The analysis of knowledge and competencies has been the subject of other researchers' work (c.f. Prahalad & Hamel 1990). The research field known as "Organisational Behaviour" also addresses this subject (c.f. Lawer & Ledford 1996).

Several researchers refer that competencies represent the knowledge and skills within the workplace needed to perform certain business functions of the organisation. At the organisational level, an employee's competency can have different levels depending on the business activity or problem-solving task. For example, a technical competency can be specified as different competencies, such as analysis, modelling, and engineering. In addition, each of them can be further specified, such as test, review, and assessment for the analysis competency. Competence levels mean a hierarchy of competencies and their areas of application that can be defined for a specific workgroup.

The business activity will define the context for the description of the related employee's competencies. According to Nonaka (1994), the competencies of an organisation include tacit and explicit knowledge, and should be conceived as a mixture of skills and technologies. In this perspective, the concepts of knowledge and competence are closely related (Lindgren & Wallstrom 2000).

Gilbert and Parlier, in 1992, had also defined competencies as a "set of knowledge, capacities of action and behaviours, structured according to an objective in a specific situation".

Meanwhile, because of the changes that occurred in organisational contexts, other concepts emerged associated with the concept of competencies. In this way, the concept was created from organisational competencies which were considered by Prochino (2001) as a co-ordination of different basis of knowledge (know-how, know-what and know-why) and its application to one (or more) product(s) or process(es).

In the same way, the concept of individual competencies has been studied by different authors like, for example, Lopes et al. (1999), who built a typology of competencies based on the typology of Guy le Boterf (1999). This typology distinguishes the following types of knowledge and capacities in competencies:

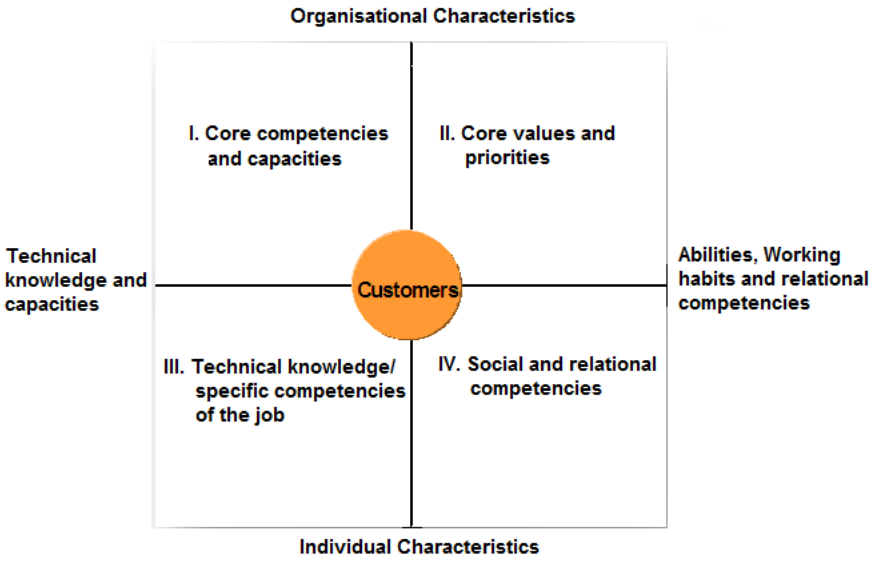
- *Theoretical knowledge*: integrates the concepts, the subject knowledge, the organisational and rational knowledge and also the technical knowledge about the context and processes, operational methods and means;
- *Know-how*: the ability to execute operations, use instruments and apply methods and procedures. This *know-how* has an operational character, a practical application or an operationalization of theoretical knowledge;
- *Social and relational know-how*: related to attitudes and personal qualities (Boterf,1999) and to the predisposition to act and interact with others, i.e., the ability to co-operate with others;
- *Cognitive capacities:* related to intellectual operations that can be simple (enumerate, compare, define, describe) or more complex (inductive generalization, constructive generalization, analogical reasoning, abstract reasoning). They describe capacities of combining different types of knowledge and co-ordinating actions so that solutions are found and problems are solved.

Historically, the word *competencies* has been used to refer to individual characteristics. However, in the concept of Boterf (2001), although the competencies always refer to the individual, they end up having two dimensions – the individual and the collective (organisational).

In this way, the concept of competencies assumes a rather large scope, which makes it complex and makes its comprehension/understanding and concept delimitation difficult.

Green (1999) tries to contribute to the clarification of the concept of competencies by presenting the different senses it can assume.

Figure 3 – Competencies Scope



Source: Green (1999)

The *organisational characteristics* reflect the identity of the organisation in which the mission, the values and its own culture are inserted.

This holds the core competencies and capacities that are reflected in the mission and in the vision of the organisation, beyond the values and core priorities that are reflected on the shared working habits and in the handbooks of conduct and ethics.

The *core competencies*[2] are the strategic competencies, which make an organisation unique and distinctive. They can be, for instance, a technical knowledge or a specific technology that can offer a unique value to the customers and that distinguishes the enterprise from the rival ones. They are the basis for the organisation to develop beyond its final products.

A core competence is the technical know-how, which is of the outmost importance for the objectives of the organisation. They are a source of competitive advantage, which is the result of the value acknowledged by the customers and it is difficult to imitate.

[2] The concept appeared in 1990, in the Harvard Business Review, in an article by Gary Hamel and C. K. Prahalad titled “The Core Competencies of the Corporation”.

The core capacities are also very important for the effectiveness of the organisation and are easily understood by the customers since “they are a set of business processes strategically understood” (Stalk, Evans and Shulman, 1992).

The *values and priorities* of the organisation aim to create a sense of community, which can lead to an increase of the workers’ trust and commitment.

They complement the technical aspects of the work and explain the reason why the work is accomplished. They imply the sharing of beliefs and cultures, including behavioural rules.

The priorities reflect the effort of the organisation to use individual competencies, such as working habits, people’s knowledge to fulfil the business and to make the working systems function in a more efficient and effective way.

An important priority of the enterprise is its will to promote the participation of the workers in order to develop its performance (Lawler, 1992).

The *individual characteristics* change the performance of the individual because they reflect themselves in the content of his/her work.

In what regards the individual characteristics, we may identify *the technical knowledge / specific competencies of the job* and *the social relational competencies*:

Technical knowledge / Specific Competencies of the Job

These types of knowledge are learnt in formal learning situations and differ according to the specificity of the job and the sectors of activity. They are the core of organisations’ strategic competencies.

Relational and Social Competencies

These competencies include working habits, communication styles, leadership forms and teamwork. These competencies are transmissible between jobs and even sectors of activity. However, they vary from organisation to organisation according to the importance that each one gives to certain competencies or to leadership / management styles adopted.

The social and relational (or behavioural) competencies are used / developed in the execution of job related tasks, but are also the support to the core values and priorities of the organisation.

These set of competencies congregate the professional profile of the employees, helping to understand how they can develop themselves, as we have seen in the 3rd

dilemma (p. 15). The better organisations know the individuals' competencies profile, the better they can explore their capabilities and stimulate them to identify and solve common problems.

2.6 The Link between Organisational Innovation and Individual Knowledge

In this point of this thesis, it is important to establish the relationship between organisational innovation and the knowledge framework. To accomplish that goal we will adopt a social ontology – Giddens' work on the structuration theory – linking his work to the concepts of organisational and innovation routines and Nonaka and Takeuchi's model of knowledge creation.

Giddens' (1984) theory of structuration details the importance of structures and social practices in the development of social systems. He outlines interrelationships between rules, resources and the creation of meaning within organisations.

One of the most important perspectives that emerged from Giddens theory of structure (1984) defines a conception that relates citizens and structure. Behaviour and structure are intertwined; people go through a socialization process and become dependent of the existing social structures but, at the same time, social structures are being altered by their activities. This means that social structures are the intermediate of human activities, as well as the result of those activities. Social structures not only restrict behaviour but also create possibilities for human behaviour.

The structuration theory is based on the premise that the classic actor/structure dualism has to be reconceptualised as a duality – the duality of structure. The dualism is reflected in the structure itself (objectivism) and in the agency (subjectivism).

Structure is regarded as a set of rules and resources. While rules represent normative elements and codes of signification, resources can be authoritative resources – which derive from the co-ordination of the activity of human agents – and allocative resources – which stem from control of material products or of aspects of the material world (Giddens, 1984).

Giddens identifies three types of structures in social systems: those of *signification*, *legitimation*, and *domination*. These are analytical distinctions, rather than distinct ideal types, that mobilize and reinforce one another.

- Signification: produces meaning through organized webs of language (semantic codes, interpretative schemes and discursive practices).
- Legitimation: produces a moral order via naturalization in societal norms, values, and standards.
- Domination: produces (and is an exercise of) power, originating from the control of resources.

To understand how they work together, consider how the meaning of a concept (i.e., the use of the expression "equal opportunities" in CEO speech) contributes to legitimization (i.e., ethical code) and coordinates forms of domination (i.e., a human resources policy), from which it, in turn, gains further force.

The term “agency” refers to the specific behaviours or activities in which humans engage. These behaviours are guided by the rules and contexts in which interactions take place.

Giddens constructs a three-tiered model of agency:

- Discursive consciousness consists of the rationally articulated justifications for action;
- Practical consciousness comprises the non-discursive framework of cultural competencies necessary for a social act;
- Unconscious motivations, tied to memory, operate below the non-discursive level as an indirect motivation for action and belief.

The theory of structuration distinguishes between discursive and practical knowledge; recognizes actors as knowledgeable, and views such knowledge as reflexive and situated, and, therefore, its habitual use becomes institutionalized.

The worker has the ability to conduct an action without needing a conscious reflection. Such actions have a nearly ritual character and the knowledge involved is a tacit knowledge: the existence of this action entails the possession of certain types of knowledge, even though the agent might not be able to completely understand this fact. These everyday actions are routinized and automatic, and practical consciousness.

However, routines of everyday life provide the agent with a sense of security and trust. We need this security to avoid situations where we are exposed to extreme anxiety and in order to maintain self-esteem.

Nevertheless, Giddens supposes that agents are in possession of a transformative capacity. This means that the agent has (potentially) the power to act differently. The concepts of transformative capacity, discursive consciousness, unacknowledged conditions, and unintended consequences of action lend the concept of agency the possibility of the invention of new social relations. Therefore, both agency and agent have a rupturable or transformative dimension.

Going back to routines, Giddens refers that organisational routines are repeated patterns of behaviour that are bound by rules and customs and that do not change much from one iteration to another.

An extended literature referrers that routines can be, on the one hand, a source of inertia and resistance (Hedberg, 1981; Levinthal & March, 1993); and, on the other hand, a source of flexibility and endogenous change (Orlikowski, 1996; Feldman, 2000; Feldman & Pentland, 2003).

In practice, participants in routines sometimes change them and this can occur for several reasons. These reasons are related to different kinds of outcomes. One reason is that sometimes actions do not produce the intended outcomes. Another is that sometimes actions produce outcomes that create new problems that need to be solved. A third reason is that rather than producing problems, actions can result in outcomes that produce new resources, and, therefore, enable new opportunities (Feldman 2000). A fourth possibility is that the outcome produced is intended but that participants still see improvements that could be made.

Each of these types of outcome is associated with a change response. When actions do not produce the intended outcome, or produce an unintended and undesirable outcome, participants can respond by repairing the routine so that it will produce the intended and desired outcome. The result intended may be to restore the routine to a stable equilibrium and may not be associated with continued change. When the outcomes enable new opportunities, participants have the option of expanding. They can change the routine to take advantage of the new possibilities. Finally, when outcomes fall short of ideals, they can respond by striving. Unlike repairing, striving is, by definition, attempting to attain something that is difficult, if not impossible to attain.

People engaged in the routine continue to alter the routine so that it allows them to do the job in a way that seems better to them.

Implementing organisational innovation practices requires not only the translation of new knowledge from its abstract formulation into an organisational setting, but it also requires its practical embedding in systematic routines and working practices and its "enculturation" in shared understandings, norms and values (Clark & Staunton, 1989; Blackler, 1995).

Change often involves challenging the existing cultural assumptions built into organisational structures and practices and their replacement with new ones. This will inevitably have implications for the relative power and influence of different individuals and groups involved in the change, and may even have more profound implications to the extent that changes, in practice, are institutionalised within the structure and/or culture of the organisation (Lukes, 1974).

Routines can perform an important role promoting shared knowledge and the spread of learning within and across organisations (Lave & Wenger, 1991; Brown & Duguid, 1991, 2001). Including agency in our understanding of routines we should think that they include a range of thoughts, feelings and actions that people experience as they engage in work.

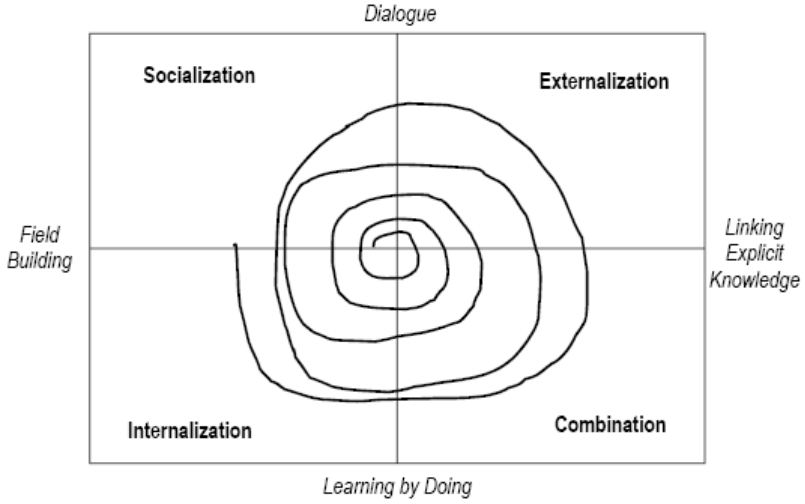
Many scholars have been concerned with how organisations learn (Argote 1999, Argyris 1976, Argyris and Schon 1978, Levitt and March 1988, Glynn et al. 1994; Schein 1993, 1996; Senge, 1990). While some of these scholars have indicated that routines are a source of organisational learning (Levitt and March 1988, Miner 1990), the view has not been widely held. We think that fact has been partly due to the lack of understanding of the potential for organisational routines to change.

Organisational routines can be a process of learning involving people doing things, reflecting on what they are doing, and doing different things (or doing the same things differently) as a result of the reflection. Thus, organisational routines can include the "double loop learning" that Argyris (1976) and Argyris and Schon (1978) have identified.

This perspective on routines is consistent in several ways with the work of Nonaka and Takeuchi on knowledge creation (1995). They claim that "seen from the vantage point of organisational knowledge creation, double-loop learning is not a special, difficult task

but a daily activity for organisations" (p. 46). They also argue that change in organisations does not simply consist of responses to the external environment, but also of internally generated knowledge. Finally, they argue that there are four modes of knowledge, and that the interconnection of these four modes in a continuous spiral represents the process of knowledge creation.

Figure 4 – Knowledge Spiral



Source: Nonaka & Takeuchi 1995, p. 71

They divide the process into four modes: 1) socialization, which is an interaction moving from tacit to tacit knowledge; 2) externalization, an interaction moving from tacit to explicit knowledge; 3) combination, an interaction moving from explicit to explicit knowledge; and 4) internalization, an interaction from explicit to tacit knowledge. They also claim that three of these – socialization, combination, and internalization – have been discussed from various perspectives in organisational theory. Externalization, on the other hand, which happens through dialogue, has been somewhat neglected. Moreover, they emphasize that unless tacit knowledge becomes explicit, an organisation cannot be truly innovative.

They explain the process as follows. Socialization creates tacit knowledge as shared mental models and technical skills, for it is a process of sharing experiences. The acquiring of tacit knowledge occurs without language, through observation, imitation and practice. The way we learn the underlying values and behavioural rules in organisations could be compared to the way we learn them as well in society.

Then, in the externalization mode we articulate tacit knowledge into explicit concepts. Nonaka and Takeuchi (1995, p. 64) state: “It is an essential knowledge-creation

process in which tacit knowledge becomes explicit, taking the shapes of metaphors, analogies, concepts, hypothesis, or models." They state that externalization is the key to knowledge creation, and see dialogue as highly important. Through dialogue, we create new explicit concepts, and the idea of shared meaning includes not only the mere articulation of meaning, but also the understanding of that meaning

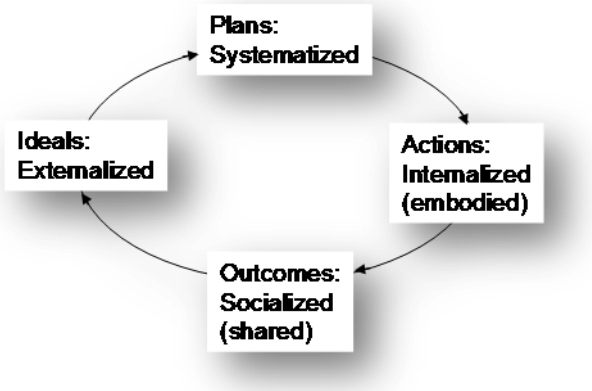
Among the four modes of knowledge conversion, externalization holds the key to knowledge creation because it creates new and explicit concepts from tacit knowledge. How can we convert tacit knowledge into explicit knowledge effectively and efficiently? The answer lies in a sequential use of metaphors, analogies, and models.

The combination mode creates knowledge together with existing knowledge, crystallizing it into new products, services or managerial systems.

The last phase is internalization, where "learning by doing" occurs, i.e. people's tacit knowledge is enriched from documents, manuals, or oral stories.

These four modes readily map onto the flow diagram of routines as shown in the following figure.

Figure 5 - A Performative Model of Learning in Routines



Starting at the top of the diagram, plans become internalised or embodied into actions. This embodied knowledge becomes shared or socialized as the actions manifest themselves in outcomes. This shared knowledge is externalised as people compare it to models or ideals. These models or ideals then become systematized as plans that can be enacted in the next iteration of the routine.

We can say that the organisational learning model takes place across levels of hierarchy within an organisation (Nonaka's and Takeuchi's, 1995), and it also happens within organisational routines. The process of change in organisational routines is also a process of organisational learning.

2.7 Conclusion

Creating a strong theoretical framework was the first goal of this research. However, this was not always as easy as we thought at first. We tried to create a framework that helped preparing and understanding the work in the field about the role of individual knowledge in organisational innovation processes in course.

One of the initial difficulties was the innovation concept. Common to all definitions that we have found is that an innovation is something new or novel. Beyond newness, definitions vary with academic perspective and application (Burgelman & Sayles 1986).

To overcome the difficulties of the concept, we adopt as a structural bases The Green Paper on Innovation (European Commission, 1996), where, by definition, “Innovation is the successful production, assimilation and exploration of something new”.

The literature also showed that an implied feature of innovation is that it must be useful (Gronhaug & Kaufman 1988; Padmore, Schuetze & Gibson 1997; Cooper 1998). This distinguishes an innovation from an invention, which may not have practical application.

Innovation is a very complex activity, mainly because researchers come from many different fields, often study specific components of innovation, and emphasise various dimensions. Therefore, a unifying general theory is yet to emerge (Abramson 1991; Eveland 1991, cited in Wolfe 1994 p. 406).

Another great difficulty that we have found was in tracing borders between organisational innovation and organisational change. Carrier and Garand (1996) argue that it is not possible to innovate without changing, but it is possible to introduce an organisational change that cannot be considered an innovation. A change can also constitute an innovation in a specific company and, eventually, not in another one.

For this research, we assumed the idea that organisational innovation leads inevitably to a set of changes in the organisation. Then, it became important to analyse the thematic of organisational change that is presented in a vast literature developed for

some of the main schools of thought – i.e., Beer and Nohria (2000); Pettigrew et al (2001); Rajagopalan & Spreitzer (1996); Van de Ven and Pool (1995).

We went through Lewin's three-phase model of change (*unfreeze-change-refreeze*) to more contemporary models like Tsoukas and Chia's work (2002) that reports that change is the norm, in opposition to the more traditional perspectives dominated by the assumption of the stability, being the change the exception.

Was also considered important to analyse the nature of change: a) radical change *versus* incremental change (assuming that the radical change modifies the total dynamics of the processes and the interactions in the companies and that the incremental change aims at continuous improvements in the processes); b) planned change *versus* not planned change (organisational change can be a planned process, guided by the management or change can be an emergent process, whose contours are going to be defined in the organisation's daily work).

As we shall see later in the field research, both companies can be classified in the incremental change process aligned with Tsoukas and Chia's (2002) perspective.

Determinants for successful organisational innovation, including origins, facilitators, obstacles and impacts, are very much dependent on the context of the organisation and its various contingency variables and will be balanced according to each organisation's unique requirements.

When we tried to explore empirical evidences about organisational innovation, some gaps in the research were evident. We have found very little work about Portuguese companies and they would, for sure, benefit from more research being done. This provides an opportunity for us because our research will focus on two Portuguese industrial organisations, helping to create field research evidences.

The knowledge framework was also a priority because the aim of this research is to analyse the perceptions of organisational actors about the role of individual knowledge in organisational innovation and change processes and in the literature we have found a strong linkage between them. We acknowledge that knowledge can be an enabler or a disabler of organisational innovation and change success, because individual knowledge transfer and use is a very complex social interaction process (McAdam and McCreedy 1999; Nonaka, Toyama et al. 2000; Von-Krogh, Ichijo et al. 2000).

To define the knowledge concept we used Davenport and Prusak's ideas (2000) that refer that "knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information". Other reference authors were Polanyi (1958) that associates knowledge to action. He says, "knowledge is the ability to act". Nonaka and Takeuchi (1997) are also a reference and they explain that knowledge is created by the flow of information associated with the beliefs and commitments of those who possess it.

It was also important to understand the nature of knowledge - tacit or explicit. Frappaolo and Wilson Todd (2000) refers that tacit knowledge is highly personalized, context sensitive and informal, and very hard to measure and manage. It includes know-how, intuition and informal communications that make up a large part of the organisation's culture. On the other hand, we have explicit knowledge (Nonaka, 1994), as an object that can be codified and distributed outside of the individual who created it (Fahey & Prusak, 1998).

To answer the main question of the research, it became important to understand how to use employee's individual knowledge to reorganize work routines and embed their knowledge into new products and services leading to sustained competitive advantage. Because this knowledge is inside each individual, the 5th Dilemma tries to understand how it can be embedded into organisational routines to fully maximize its utility.

However, we found several sharing barriers in the literature: a) individual barriers, grounded in the participants of the knowledge sharing process (e.g. the fear to lose personal competitive advantage and to be misunderstood and misinterpreted, group thinking, preference to one's own ideas instead of somebody's else, etc. - Husted and Michailova, 2002); b) infrastructural barriers, determined by organisational structure, system of communications and organisational culture (Bock et al, 2005; Hall, 2002); c) ontological barriers, dealing with the knowledge itself and arising from the tacit knowledge transfer problems (Nonaka, 1991), as well as from perceived value of knowledge (Ford & Staples, 2005) that is often not recognized at all by the knowledge sharing participants (Hall, 2002).

Some of these barriers we also found later on in the field research, conditioning knowledge sharing as we acknowledged in the 2nd research dilemma. In Efacec, Automação e Robótica there is not any system or mechanism to facilitate the share and because they work in the client organisation, and the departments work as

independent units, it is more difficult to create a culture of knowledge share. In BOSCH TERMOTECNOLOGIA SA, they have a culture of knowledge share, but face some obstacles such as the eldest workers' resistance and few qualifications which difficult the understanding of some kind of knowledge in the organisation.

In respect to competencies' development, we used Gilbert and Parlier (1992) definition: "competencies are a set of knowledge, capacities of action and behaviours, structured according to an objective in a specific situation".

We assumed that competencies represent the knowledge and skills within the workplace needed to perform all functions of the organisation. Boterf (1999) and Green (1999) typologies of competencies will help to create our own model to identify and organise competencies found in the field work related to knowledge profiles, and help the organisation to step to a next level of development.

To establish the relations between organisational innovation and knowledge framework we adopted Giddens' work on structuration theory. We linked his work to the concepts of organisational and innovation routines, together with Nonaka and Takeuchi's model of knowledge creation. The theory of structuration distinguishes between discursive and practical knowledge, recognizes actors as knowledgeable, and views such knowledge as reflexive and situated, and, therefore, its habitual use becomes institutionalized.

Several authors (Clark & Staunton, 1989; Blackler, 1995) refer that implementing organisational innovation practices requires not only the translation of new knowledge from its abstract formulation into an organisational setting, it also requires its practical embedding in systematic routines and working practices and its "enculturation" in shared understandings, norms and values. As we shall see in the field research, specially in BOSCH TERMOTECNOLOGIA SA, organisational routines are a process of learning involving people doing things and solving problems, reflecting on what they are doing, and doing different things (or doing the same things differently) as a result of the reflection.

This perspective on routines is consistent, in several ways, with the work of Nonaka and Takeuchi on knowledge creation (1995). They claim that "seen from the vantage point of organisational knowledge creation, double-loop learning is not a special, difficult task but a daily activity for organisations" (p. 46). They also argue that change in organisations does not simply consist of responses to the external environment, but

also consists of internally generated knowledge. Finally, they argue that there are four modes of knowledge, and that the interconnection of these four modes in a continuous spiral represents the process of knowledge creation.

In the field research, we will discuss forms of interaction in order to share tacit and explicit knowledge, supported by the base idea of Nonaka and Takeuchi's Knowledge Spiral. However, we will not use the categorisation of the model (Socialization, Externalization, Internalization, and Combination), because we think that the processes of creation and use/share of knowledge cannot be separated. It is a dynamic process that blends all forms of knowledge share.

Finally, it seems to be important to point out that few researchers have examined the share and use of individual knowledge in organisational innovation processes. This is probably due to the fact that innovation and knowledge are relatively new research areas and that they are difficult to measure. With this research we try to clarify organisational innovation and knowledge sharing concepts, devoting our attention to these vital activities.

In the next chapter, we will discuss the methodology of research that we have adopted: Action Research.

CHAPTER 3 – ACTION RESEARCH – A METHODOLOGIC APPROACH TO INNOVATION AND ORGANISATIONAL CHANGE

3.1 Introduction

In this chapter, we will try to do a literature review of the Action Research (AR) methodology, confronting it to quantitative methodologies.

It's important to understand what AR is, and in what it differs from traditional methodologies, namely the fact that it is a learning process for all the participants – practitioners and researchers – instead of being only a set of data collection techniques.

In the next points of the chapter, we will try to show that it is possible to use a set of techniques, but also that the role of the researcher is crucial and that he is seen as an equal during the research.

AR is designed to deal with and respond to 'real-world' situations, unlike mainstream research where you can, and should, start with a very precise research question. Since

this research's main goals was to understand if organisational actors have different perceptions of the individual's knowledge use and share, only the Action Research methodology could help understand this phenomenon, not only because of the necessary closeness to all the organisational actors, but also because of the share of mutual knowledge that was possible to obtain in all the group recall sections.

With the group recall technique we will make several meetings that will be a special space to share ideas and opinions about the organisation and the ways and mechanisms people normally use to share knowledge among themselves and also the obstacles they have to face. In addition, all the ideas and experiences that were shared in the group recall made people become more aware of what was going on in other departments and what kind of procedures and features each department used to share knowledge.

The role of the researcher, as well as his background, was very important for the share facilitation. His participation implied total collaboration. This is important for knowledge acquisition and share, through the social interaction among all actors.

3.2 What is Action Research?

Action research is a methodology of practice - a concept that contrasts strongly with the mainstream methodology tradition. "We are accustomed to distinguishing between theory and practice, between thought and action, between science and common sense" (Argyris et al. 1985 p.1).

One main characteristic and strength of AR becomes clear: it suggests an intervention carried out in a way that may be beneficial for the organisations participating in the research study. Previous work suggests that this characteristic of AR leads to the development of a stronger linkage between organisations and researchers and to organisational development and improvement (Ledford and Susan, 1993a; Sommer, 1987).

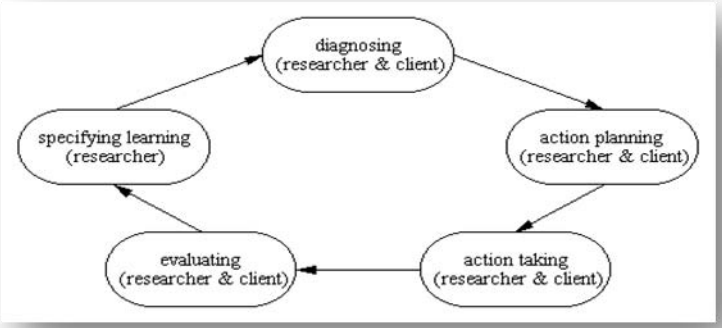
Thiollent (1997) pointed out the main characteristics of AR:

- Orientation for the future;
- Contribution between researchers and practitioners;
- Development of the capacity of the system to identify and to decide problems;

- Possibility of theories' development based on the collaboration and partnership between researchers and practitioners;
- The relations established during the research situation are not totally predictable.

AR is a learning process for all the participants: practitioners and researchers. Susman and Evered (1978) view a general AR project as a cyclical process carried out through what these authors refer to as the AR cycle, comprising five stages: diagnosing, action planning, action taking, evaluating, and specifying learning. The *diagnosing* stage involves the identification and definition of an improvement opportunity or a general problem to be solved in the client organisation. The following stage, *action planning*, involves the consideration of alternative courses of action to attain the improvement or the solution to the problem identified. The *action taking* stage involves the selection and realisation of one of the courses of action considered in the previous stage. The *evaluating* stage involves the study of the outcomes of the selected course of action. Finally, the *specifying learning* stage involves the study of the outcomes of the *evaluating* stage and, based on this study, knowledge building in the form of a model describing the situation under study.

Figure 6 - The Action Research Cycle



Source: Susman and Evered (1978)

Initially, this model was expected to be only descriptive, rather than predictive. However, the researcher's deep involvement with the environment being studied, together with time constraints, lead, to the study of a small number of instances of particular events. However, as the number of AR studies carried out on a similar topic grows, their resulting descriptive models can then be integrated into more general and predictive models, and eventually lead to "grand theories" (Strauss and Corbin, 1990).

The classical non-participatory approach to AR usually prescribes that all stages but one, the specifying learning stage, be carried out in cooperation with the client organisation (see Figure 1). More contemporary approaches to AR, such as participatory AR, strive for the full involvement of the client organisation in the specifying learning stage as well (Elden and Chisholm, 1993).

Susman & Evered (1978) acknowledge that action research projects may differ in the number of phases carried out in collaboration between the action researcher and the client system. In particular, they point to the case where the researcher may only be involved in collecting data for diagnosis and feeding this back to the client system. Another example involves the researcher evaluating the actions undertaken by the client system and feeding data back to it.

Contemporary applications of AR enable the use of different techniques for data and information collection, especially in the diagnosing and evaluating phases. These may include the use of questionnaires, semi-structured interviews or focus groups, group recall, with the choice often largely dependent on the researcher's skills and background. Literature reviews also commonly use records, memos, and reports from the client system.

3.3 Origins of Action Research

Action research has been considered a distinctive form of research since the early 1940s. Kurt Lewin is generally regarded as one of its pioneers (Checkland, 1981; Argyris, Putnam and Smith, 1985). He was the first author to use the term "action research" to refer to a specific research approach in which the researcher generates new social knowledge about a social system, while at the same time attempts to change it (Lewin, 1946; Peters and Robinson, 1984).

Early published material suggests that AR grew from researchers' desire to deal with important social problems. However, in the late 1940s, AR begun to be used in a large scale to deal with intra-organisational and work life problems in Sociotechnical Studies and Organisational Development. Most of the AR practice in the second half of the 20th century has continued and expanded this organisational and work life focus, and one of the major topics of AR has been the issue of "job satisfaction" and its dependence upon several aspects of work situations (Gustavsen, 1993).

The recognition that a social system can be more deeply understood if the researcher is part of the socio-technical system being studied, gave AR a major importance. In the

organisational context, the involvement of the researcher can foster cooperation between researcher and those who are being studied, information exchange, and commitment towards both research quality and organisational development.

Nevertheless, AR has been the target of severe criticism from positivists, who typically view experimental and survey research as the only "valid" modes of scientific inquiry.

3.4 AR versus Positivism

Action research is constantly referred to as opposed to positivist research methods (Kock and Corner, 1996). In fact, the two main positivist tenets - the belief that there are universal and permanent laws or principles that represent unidirectional causal relationships, and the belief that there is only one real "scientific" method to unveil those relationships (Walker, 1993; Guba and Lincoln, 1994) - are openly questioned by AR practitioners who, for example, do not accept the endorsement of "appropriate" research methods.

A number of AR practitioners have tried to bridge the gap between positivism and AR by describing "classical" AR as a form of field experiment, which is by nature "low" in control, and they cite the early work of AR practitioners such as Kurt Lewin to support their claims (Elden and Chisholm, 1993). However, this view has been questioned by others who state that the approach proposed by controlled experiments, even if this control is minimal, is often inappropriate since unilateral control of some variables by the researcher would prevent conclusions based on a "natural" process. The AR purpose, they maintain, is not experimenting but rather discovering correlational and/or causal couplings between variables in situations where learning and change flow naturally from research interventions.

Sample surveys and controlled experiments are often pointed out by positivists as the preferred types of research, and inferential statistics the method to discover causal laws. However, even though survey research and controlled experiments are seen as providing a rigorous basis for the statements that are made, AR practitioners point out that these methods cut off the researcher from the discovery of non-deterministic and reciprocal relations in social systems (Jonsonn, 1991).

One of the main criticisms of AR by positivists is that in looking at AR strategies in a historical perspective, the development of research procedures, techniques and methodologies has not been the main goal. Rather, AR has been preoccupied with the action itself and its influence on the settings in which research is done (Gustavsen,

1993). This often leads researchers into seeing AR projects as merely to solve practical problems and, at best, generating normative approaches and methodologies, rather than valid research knowledge obtained in a rigorous way.

Three main possible AR weaknesses emerge from the discussion by Orlikowski and Baroudi (1991) about the clash between positivist and non-positivist assumptions and, therefore, seem to require particular attention in the development of methodological tools for improving AR rigour from a positivist perspective:

- *Contingency of the research findings*. AR is often seen as inappropriate to produce models with high external validity that is valid outside the context of the AR project (Cook and Campbell, 1976; Berkowitz and Donnerstein, 1982). This is because most AR projects involve a small number of organisations in in-depth and often longitudinal studies (Galliers, 1992).

- *Low control of the environment*. This lack of control is one of the main reasons for AR being seen as inappropriate to test or produce strong theories, or build up research models based on solid evidence. The influence of a particular variable might take too long to be isolated in AR studies testing or refining a causal model where the extent to which a dependent variable is influenced by a set of independent variables needs to be carefully examined (Jonsonn, 1991).

- *Personal over-involvement*. The usual personal over-involvement of researchers with organisations in AR projects may hinder good research by introducing personal biases in the conclusions (Francis, 1991).

Other alleged weaknesses have been discussed by Rapoport (1970) - AR typical unplanned and informal structure. The ad-hoc approach of AR, where most of the study is done in cycles with temporary reports, methodologies and frameworks, may be considered as lacking scientific discipline and consequently regarded of low academic interest. However, this is one of the crucial aspects of AR, because it is important to analyse the flow of the organisation itself. It is not so important to plan a set of research activities that cannot help solving real organisational problems.

Another alleged weakness is AR's interference with the research environment that, while potentially beneficial to the organisation, may bias research findings in ways that are difficult to be identified, and make them difficult to be replicated by other researchers in different settings. A third alleged weakness is the lengthy time required

to conduct quality AR projects, which may not be acceptable by the research's sponsor or client.

However, AR, in contrast to positivist research approaches, tries to bridge the gap between scholars and practitioners. While typically scholars are preoccupied with philosophy and general theories, practitioners are more concerned with problem solving and bottom-line techniques. Sommer (1994) states that society is the victim of this dichotomy as research outcomes often end up forgotten on some dusty shelf without any practical application other than support further theoretical research. This point is supported by Jonsonn (1991) who also maintains that the contribution to theory is not affected in AR because the study is done much more deeply as the researcher has an inner involvement with the environment. AR is seen as adding texture to theoretical notions and food for theoretical speculation, and a way of dealing with complexity in the presence of oversimplified theory.

The positivist research outcomes is the confirmation or rejection of knowledge stated in the form of hypotheses or a model to be tested, while the main contribution sought by AR is to build up or enhance an existing model or theory by selective intervention.

In particular, positivist science has proved to have some deficiencies whenever it has been removed from the closely defined laboratory setting and asked to cope with the kind of organised complexity facing humanity and the life sciences in the 'real' world (Checkland 1981). In fact, Lewin's concern that mainstream science was not helping in the resolution of critical social problems was the driving force for the development of AR (Susman & Evered 1978). In mainstream social science, implementation has been seen as a problem of application, of practice, perhaps of politics, but not of theoretical science (Argyris et al. 1985). From the perspective of action research, however, implementation is not separable from crucial theoretical issues.

As Bunning (1995) points out, action researchers seek to influence the phenomena being studied during the AR process itself, in the belief that the true nature of social systems becomes most evident when you seek to change them. Because of this interventionist approach, the experimental standardisation of positivistic research is neither possible nor desirable. Similarly, because action research thus addresses whole system issues that are invariably multi-variate, these are best approached within a qualitative and holistic framework, rather than a reductionist and quantitative framework.

Another contrast between action research and mainstream science is that AR is focused on what could be, rather than what is. "New thinking in AR seems to take the social construction of reality seriously. The emphasis is on possibility rather than prediction. From a constructivist perspective, AR can contribute to people realizing their values, envisaging a preferred future and organizing effectively to achieve it" (Elden & Chisholm 1993 p.127). As these authors go on to point out, this highlights how action researchers are not 'value neutral', but rather concerned with selecting problems to solve that would both contribute to general knowledge and practice solutions concerning democratic, humanistic values. In this way, AR is change oriented and seeks to bring about change that has positive social value (e.g. healthy communities, environmentally sound management, etc.). These points and others that contrast the differences between mainstream science and action research are outlined in the next Table.

Table 7 - Comparisons of positivist science and action research

Points of comparison	Positivist science	Action research
Value position	Methods are value neutral	Methods develop social systems and release human potential
Time perspective	Observation of the present	Observation of the present plus interpretation of the present from knowledge of the past and conceptualization of more desirable futures
Relationship with units	Detached spectator; client system members are objects to study	Client system members are self-reflective subjects with whom to collaborate
Treatment of units studied	Cases are of interest only as representatives of populations	Cases can be sufficient sources of knowledge
Language used for describing units	Denotative, observational	Connotative, metaphorical
Basis for assuming the existence of units	Units exist independently of humans	Human artefacts for human purposes
Epistemological aims	Induction and deduction	Conjecturing, creating settings for learning and modelling of behaviour

Criteria for confirmation	Logical consistency, prediction and control	Evaluating whether actions produce intended consequences
Basis for generalization	Broad, universal and free of context	Narrow situational and bound by context

Source: Susman & Evered 1978, p.600

The reason for the flexibility of action research methodology is that it is designed to deal with and respond to 'real-world' situations, unlike mainstream research where you can - and should - start with a very precise research question. Given a precise research question, a study can then be designed to answer it with equal precision. However, given the nature of the social systems, action research design cannot be fully detailed in advance and then rigorously and inflexibly implemented. Rather the research design is emergent, meaning it develops progressively, influenced by the events that take place during the project and by the progressive analyses that are made. In action research, the use of the elements that bring rigour into mainstream research (control, standardisation, etc.) would defeat the purpose. "The virtue of action research is its responsiveness. It is what allows you to turn uncompromising beginnings into effective endings. It is what allows you to improve both action and research outcomes through a process of iteration" (Dick 1993).

This in no way intended to criticize or invalidate quantitative research, but rather to show that when contextual patterns are important to the research, qualitative methods are preferred. The argument for qualitative research to gain understanding of how employees think, feel, and respond to organisational innovation and change was also verified by Neuman (1997). The following table makes a comparison of qualitative and quantitative research (p.14), point out the main differences:

Table 8 – Qualitative Research versus Quantitative Research

Qualitative Research	**Quantitative Research**
Assesses cultural implications	Assesses objective facts
Focuses on events	Focuses on variables
Must be authentic	Must be reliable

Few cases, few subjects	Many cases, many subjects
Thematic analysis	Statistical analysis
Researcher is involved	Researcher is detached

Source: Neuman (1997)

3.5 Role of Researcher

AR comprises a family of research methodologies that aim to pursue action and research outcomes at the same time. Therefore, it has some components that resemble consultancy or change agency, and some that resemble field research. The focus is on action in order to improve a situation and the research is the conscious effort, as part of the process, to formulate public knowledge that adds to theories of action that promote or inhibit learning in behavioural systems. One of the key characteristics of this approach is collaboration, which enables mutual understanding and consensus, democratic decision-making and common action (Oja & Smulyan, 1989, p.12).

In this sense, the action researcher is a practitioner, an interventionist seeking to help improve client systems. "This help takes the form of creating conditions in the behavioural world of the client system that are conducive to inquiry and learning. Lasting improvement requires that the participatory action researcher help clients to change themselves so that their interactions will create these conditions for inquiry and learning" (Argyris et al. 1985 p.137). Hence, action research aims not only at contributing to the practical improvement of problem situations and developing public knowledge, but it also at developing the competencies of people when facing problems.

Within this broad definition, there are four basic themes: a) collaboration through participation; b) acquisition of knowledge; c) social change; d) empowerment of participants. The process that the researcher uses to guide those involved can be seen as a spiral of action research cycles consisting of phases of planning, acting, observing and reflecting (Masters 1995). As Oja and Smulyan (1989) point out, the underlying assumption of this approach - which can be traced back to Lewin's writing in 1948 - is that effective social change depends on the commitment and understanding of those involved in the change process. In other words, if people work together on a common problem "clarifying and negotiating ideas and concerns, they will be more likely to change their minds if research indicates such change is necessary. Also, it is

suggested that collaboration can provide people with the time and support necessary to make fundamental changes in their practice which endure beyond the research process" (Oja & Smulyan 1989 p.14-15).

While personal involvement from the part of the researcher is likely to bias research results, it is inherent in AR because it is impossible for a researcher to have a detached position and, at the same time, exert positive intervention on the socio-technical system being studied. This is particularly true when the number of situations experienced by the researcher is small and the intensity of his involvement is high.

Due to the level of involvement, AR researchers and practitioners may perceive events and situations in different ways, especially when these situations involve conflict, stress, or any events that may lead to an intense emotional response. AR interventions foster change and change is always met with resistance and apathy by some, and support and enthusiasm by others. The clash between those who believe that the status quo in the organisation should be maintained and the change enthusiasts is likely to catch AR researchers and practitioners right in the middle.

The main benefit likely to accrue to AR researchers and practitioners as a result of successive iterations in the AR cycle is that disconfirmatory evidence in further iterations may help correct distortions in the findings of previous iterations caused by personal involvement.

Since the project is expected to be also a "research" study, both organisation and researcher are expected to learn from it. In turn, by establishing conditions for the development of others, the action researcher acquires increasing skills in such things as the ability to build shared vision, to bring to the surface and challenge prevailing mental models, and to foster more systemic patterns of thinking. To paraphrase Senge (1990), action researchers are responsible for building frameworks and networks through which people are continuously expanding their capabilities to shape their future. That is, action researchers are responsible for developing a learning environment that challenges the status quo and generating liberating alternatives (Argyris et al. 1985).

Because the research involves complex and dynamic problems, exploring the social process of learning about situations is inextricably linked with the acts of changing those situations. In these systems, the researcher must actively participate with others in the critical exploration of complex and dynamic issues of implementation that relate

to the relationships between individuals, groups and their physical and socio-cultural environments. Furthermore, success in social change is not achieved simply by making the right decision at a particular time, but rather through developing a social process that facilitates ongoing learning (e.g. Korten 1980, Whyte 1989).

The researcher believes in the ability to predict objectively people's actions and believes – even if it is questionable that people's actions can be truly predicted – with the same certainty as if those people were explaining their actions. "Behind this mode of viewing the other in the research act is the will to control circumstances and consequences through the control of the actions of people" (Kemmis, 1991 p.59).

Above all, the role of the action researcher cannot be described as either 'objective' or 'subjective'; it is both. He aims at developing or improving people's actions understandings and situations through collaborative action. He is a 'change agent' that changes his own behaviour in interaction with others and leading changes to the relationships and the processes (Dick 1996). He can also influence the decision-making processes and the prevailing culture.

3.6 Creating and sharing knowledge through action research

AR is characterized by the adoption of interrogative-critical procedures that help identifying solutions. This interrogative nature is based on the formularization of questions that will help create and share critical knowledge.

This process consists in collecting information and unchaining an argument related with facts of the researched situation. The critical aspect estimates one non-acceptance of the "spontaneous explanations" that are given by the actors or by common sense. Here the researcher performs an important role making in evidencing problematic aspects in general or related to interests or conflicts.

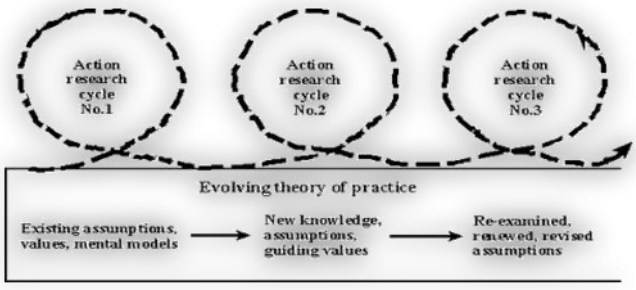
The researcher can use some interactive techniques like the diagnosis that can make possible an ample exchange of knowledge between the involved actors (researchers, practitioners and other organisational members). The diagnosis, considered as inevitable, need the contribution of the members of the organisation, allowing the understanding of the situation's context.

The process adopted cannot be limited to data collection since it is also important to promote the dialogue so it can be possible to share knowledge in the quest for solutions. In this context, the space of discussion created during the research allows

all people to be involved in the problems, even if they don't find definitive and acceptable solutions for all (Kuhne et al, 1997).

The use of repeated cycles (Susman and Evered, 1978) enables the creation and share of knowledge, giving AR an interactive nature (Figure 2).

Figure 7- The interactive nature of action research



Source: Damme, 1998

People create knowledge based on their concrete experience using their values and mental models, observing and reflecting on their experiences, by forming abstract concepts and generalizations about what to do next and by testing the implications of these concepts in new situations, which will lead to new concrete experiences.

Above all, the AR methodology looks for an increase of the knowledge and conscience of the individuals and the involved groups in the process, through the definition of concrete shares that can help the self-knowledge of the organisation. This objective is reached through research, through the spreading of information and through the discussion of the results between all the participant actors.

3.7 The reflection process in action research

Thus, in some ways, action research tends to be cyclic, participative, qualitative and critically reflective. All of these features (except the last) can be seen as choices to be made by the researcher in the context of the problem being studied (Dick 1993). In addition, it is this process of critical reflection that distinguishes action research from everyday inquiry (Dick 1996, Wortley 1996, Bunning 1995), making it a particularly suitable approach with which to help develop the change needed for areas such as environmental management and sustainable development. Indeed, in the sense that action research seeks alternatives to the *status quo* that will both illuminate what exists and inform fundamental change, it is a form of critical theory and seeks to stimulate

critical reflection among human agents so that they may more freely choose whether and how to transform their world (Argyris et al. 1985).

It is the process of reflection that provides the basis for learning, enabling all those involved to develop a more holistic perspective of any given situation, within which they can best make their particular contribution.

The challenge for the action researcher lies in the fact that learning can be difficult, even at an individual level. Accepting new information that challenges the way we think and the things we do is, even with the best of intentions, difficult to undertake, to accomplish, and to sustain. Finding out about problems also implies that we may have to act to correct them. What often stops us from doing this is anxiety or the feeling that if we allow ourselves to enter a learning or change process, if we admit to ourselves and others that something is wrong or not right, we will lose our effectiveness, our esteem, and maybe even our identity. Most of us need to assume we are doing our best at all times, and it may prove a real loss of face to accept and even "embrace" errors. Adapting poorly or failing to realize our creative potential may be more desirable than risking failure and loss of esteem during the learning process (Allen & Kilvington 1999).

Schön (1987) refers that the reflection on organisational practices is created under the premise that we need to question everyone's actions. This suggests a process of learning from experience. Having this in consideration, several types of reflection can be pointed out:

- Reflection on promoted actions;
- Reflection on the record of field notes, since that could help analyze the situations' development;
- Reflection on the actors' records, comments and answers in order to help disclose details of the change process that in other ways would be impossible;
- Reflection on the interventions' results with all the actors involved in the process.

3.8 Conclusion

The paradigm for what constitutes important and valid research continues to expand from quantitative to qualitative methodologies. There are more and more scholars and practitioners that struggle with the best way to help organisations change in real time.

Action Research is a methodology of intervention that consists in associating the research and the practice in a process in which the implied actors participate interactively trying to understand the reality, identifying problems and trying different solutions (Kuhne et al., 1997).

In this context, there is a shift in the paradigm research and the role of the researcher is changing from observer to an actor involved in the process (Arbnor and Bierke, 1997). Instead of maintaining a supposedly objective distance from the situation, the researcher seeks to disturb it as little as possible. He than collects information in several different moments so that the learning process is done in a continuum, although it can be more intense in specific moments previously planned. The process then becomes more dynamic than if it was just done in a single research moment.

The practitioners can also be active participants, helping to shape the research question, helping to generate and analyze data, and then, through the use of new information, help change their own behaviour.

Methods used to generate data comprise several qualitative research techniques such as interviews, surveys, focus groups, group recall, observation, reflection, document review, etc. In addition, quantitative techniques may also be used if appropriate. Data gathered through these means could be given as feedback to the participants, who then may choose to make other changes. This cycle is a way to create new knowledge and to learn within the applying process.

According to several authors (Elden, 1983; Elden&Levin, 1991; Greenwood&Levin, 1998), AR includes the creation of local theory. This kind of theory can be defined as a co-creation theory of change that enables the participants (both participants and researcher) a greater control over the circumstances, and to function more effectively.

This research has a particular interest in the creation of local theory using AR methodology and this is the main goal of the next chapters.

CHAPTER 4 – FIELD RESEARCH

4.1 Introduction

This chapter describes the field procedures followed in organisations, although this research is carried through the qualitative methodology of action research. AR implies a direct participation of the researcher in the process, which can lead to a very rich description of the innovation and change process, otherwise very difficult to achieve by the traditional methods of collecting data. The quality of this participation can be seen, in the point of view of research, as important as the results of the intervention itself.

Casell and Symon state that “qualitative research can be said to have a number of characteristics which include: a focus on interpretation rather than quantification; an emphasis on subjectivity rather than objectivity; flexibility in the process of conducting research; an orientation towards process rather than outcome; a concern with context regarding behaviour and situation as inextricably linked in forming experience; and finally, an explicit recognition of the impact of the research process on the research situation” (1994:7).

What can be discovered by qualitative research are not generalisations, but contextual findings and rich insights not available in more rigorous but constrained quantitative research. It allows a deeper analysis and a different understanding of complex organisational problems.

For this research, the qualitative analysis is the most adequate because the goal intended is not concerned with measuring the effects of change, but the analysis of the convergence between individual knowledge and the direction of change.

Why AR methodology? Because this research is "a social research with empirical base (...) in which the researcher and the other participants are involved in a collaborative way" (Fals-Borda et al. 1991). This cooperation between the researcher and other participants in the process is very important for this research’s success, and it will contribute to define the use of the more adequate techniques and tools to accomplishment the organisational innovation and change processes.

McKay and Marshall (2001) attribute this to an overemphasis on the problem-solving aspects of AR (the practitioner’s interest) at the expense of its role as a vehicle for theory development and evaluation (the research interest).

On the other hand, most organisational studies often lack critical depth, because many of the research findings are based on statistical analysis of simple cause-and-effect relationships. Typically, results appear as lists of factors, with no clear link to underlying data in terms of cited evidence or an explicit method of theory generation.

The main idea was developing frameworks that seek to emphasize sustainable people-centred research and development and we can look towards the body of knowledge that has already been generated through action research.

It is undeniable that a low degree of control over variables of the socio-technical system being studied can hamper the test of causal links between these variables. Testing links between variables, however, requires both variables and links to be clearly stated before the research project starts. This is in turn likely to limit research findings by focusing the research on a limited set of variables and leaving out others that might be relevant for the understanding of the events under consideration.

Given the problems above, one can say that the low control over the environment being studied, characteristic of most AR projects, is more of an advantage than a disadvantage in the generation of relevant and valid knowledge.

However, the low control of variables, which prevents manipulation to generate highly focused data, leads researchers into collecting a large amount of data. This not only allows the collection of data from different sources about the same variables and events, but also gives a desirable form of triangulation in research data collection.

Finally, I have some personal reasons for choosing action research as a research methodology for this project.

Firstly, the phenomenon I was studying did not seem to fit traditional research methods as I was studying the use that employees gave to their individual knowledge in the innovation and change process.

Secondly, I was interested in doing something that very few people have done in Portugal, and that could bring some light in organisational innovation and change processes.

Thirdly, one of my supervisors suggested this methodology and both of them showed a great enthusiasm in using it.

4.2 The Group Recall Technique - Sharing Knowledge in the Research Process

In this research, the group recall technique was used in order to share the knowledge among the researcher and the organisational actors. This is a qualitative technique created by Professor Peter Totterdill and his research team in Nottingham Trent University and applied in their researches.

The group recall technique can be framed in social research and the process is similar to focus group process. It gives the researcher the opportunity to hear detailed revelations about people's thoughts, ideas, and experiences. It has potential to illuminate workers' contrasting opinions and experiences and to help them getting to know better the organisation, and sharing with colleagues their experiences and work practices.

The researcher conducts group recall sessions with a number of workers from one organisation at the same time in the same venue. It is a space for knowledge sharing through dialogue and it is capable of generating particularly high quality data.

Two main actors participate in the group recall process: the researcher, who has the capability to decide the design and direction of the research; and the researched, who can condition the success of the research with his involvement and participation in sharing their remembrances about their work experiences.

The group recall session is influenced by the number of participants, that should be no less than 2 and no more than 5 so that everyone has enough space to express their ideas and remember their work stories, practices and experiences.

The combined contributions of the participants of the group recall might point up new directions and questions changing the trajectory of the session. There is then potential for the researcher to explore their remembrances allowing space for participants to articulate their own ideas.

The practical issues of group recall sessions are mainly the logistics of getting all participants together at the same time in the same room, prepared to talk on the same subject and the concerns that some contributions might become lost in the wider debate.

One main concern about the use of this technique is the danger of censoring: individuals hold back the contributions they wish to make, conforming instead to an apparent consensus or to the opinions of a self-appointed "expert" within the group. Another concern is the possibility for participants to exaggerate their accounts in order

to “impress” others. However, and because several participants could belong to the same work unit, this was unlikely to happen since the other members of the group would function as a control elements.

Moreover, its important to point out that, whatever research tool is used for data collection, the power over data analysis remains in the hands of the researcher. As Maynard and Purvis (1994) have cogently argued, knowledge always bears the marks of its producer.

Finally, and as an output from this research, it’s important to identify the researcher’s key responsibilities associated to group recall technique.

Table 9 – Researcher’s Group Recall Responsibilities

Role	Responsibility
Researcher - organizes the group recall sessions, focuses on communications between and among group recall participants. This is accomplished in informally face-to-face sessions.	– Clarify communications – Draw out the reticent – Ensure that dissenting points of view are heard and understood – Keep discussions on the topic – Reconcile opposing points of view – Ensure and articulate a valid purpose for the group recall realisation – Stimulate interest in the group recall – Organize face-to-face group recall sessions – Stimulate organisational actors’ participation – Arrange for communications support – Obtain official support when appropriate – Communicate the contributions of the group recall sessions to the formal organisation

To assume a concept of knowledge share, I have analysed the existing literature and have concluded that it did not reveal knowledge sharing as a well-defined concept. Therefore, it is necessary to establish what we mean by knowledge sharing.

The term knowledge sharing implies the giving and receiving of information framed within a context by the knowledge of the source. What is received is the information framed by the knowledge of the recipient. Although based on the knowledge of the source, the knowledge received cannot be identical as the process of interpretation is subjective and is framed by our existing knowledge and our identity (Miller 2002).

Knowledge sharing intrinsically implies the generation of knowledge. For instance, in face-to-face communication, an effective mechanism for gaining knowledge is to request help from another, i.e. someone who may possess the knowledge or expertise required. This request may lead to a conversation that will facilitate the creation of new knowledge. This suggests that in face-to-face interactions, conversations can be an effective conduit for knowledge sharing.

Conversation is the most common mean that facilitates the transfer and development of the more deeply rooted tacit knowledge. The context is built through communication and is enabled by a shared perspective, by language and a common understanding.

4.3 My role as a researcher

The first assumption that I have made in choosing a methodology is that my research should have a practical use and AR methodology provides interplay between “theory” and “practice”.

The second assumption I have made is that whatever research was to be carried out, it should have practical implications. Therefore, the testing of 'actions' and adjustments to actions based on the results was expected. The cyclical approach of action research and action learning where you shuttle between action and reflection had to be part of my methodology.

Using the action research methodology, the researcher tries to identify the more adequate methods to accomplish certain activities; to participate actively in the change process and to collaborate with the consultants and Technicians involved in the process. This research requires a high complicity between all those involved so that together they can define the problems and the more adequate solutions to organisational problems.

According to Benbasat, Goldstein & Mead (1987), AR can be considered as a type of case study. However, the researcher soon stops being a simple observer and starts participating in the process of implementation. On the other hand, the process of change becomes a research object. The researcher has two main goals: to act to solve a problem and to contribute with a set of concepts for the development of the system.

In this research, the goal is to analyze people's perceptions about the organisational innovation and change process. These perceptions will help understand how they use their knowledge in the process. There will be several group recall sessions, where each team will discuss some organisational dilemmas.

With these, I intended to:

- Transform informal knowledge into explicit knowledge about organisational dilemmas that emerge from the organisational innovation process;
- Understand the organisation's dynamic when using individual knowledge to improve its performance;
- Provide the researcher the means to analyze the company so that he can verify as the organisational change is being implemented;
- Increase the understanding of people's organisational and social context in their work place.
- Propose a research methodology that can contribute to the implementation of successful organisational change.

The question is how can the researcher transform the informal knowledge into some kind of knowledge that can be used in the study of the organisation through action research?

According to Argyrys & Schön in Macke (1999), action research creates descriptions and theories inside the organisational context and evaluates these descriptions and theories through interventions, whose main goals are to answer research questions and to promote organisational changes.

The goals of this type of research are to produce new information, to structuralize and to make possible to share the knowledge that emerges. The information generated is based on comment and interrogative techniques in order to help built new certainties between the actors. Thus, within action research, a diagnosis space of possible

solutions is created and the share is unchained so that, in turn, they can be the object of research and evaluation. The learning that results of this process forms the base of a possible advance in the organisations' practical knowledge.

To conceive and carry out action research in organisations, it is necessary to have a long term or medium term theoretical and practical investment, so that one can rethink the organisation and its culture, appealing to the participation of all actors.

Following Reason et al. (2001) suggested procedures in the forms of interaction between practitioners and researchers or consultants, I should:

1. Do a diagnosis to identify a problem in the organisation.

2. Plann the share process, considering alternative shares to decide the problem.

3. Execute the shares.

4. Evaluate of the consequences of the share.

5. Evaluate the specific learning and identify the resulting learning of all the process, evidencing the knowledge that was acquired and if it can be generalized.

There is a necessity intervention in organisations that are inherent to action research. In this research the organisational intervention is based in the collection and share of knowledge between the researcher and the consultants and Technicians of innovation, in order to define the proposals of solutions for the specific situations in each organisation that participate in the study.

Action research can be directive, whenever the researcher drives the process of change. In this in case, it will be a non-directive research since the researcher will collaborate with the organisational actors in the search of new/other conceptions and approaches for the process of organisational innovation and change.

4.4 Methods and techniques

The same methods and techniques were used in EFACEC and BOSCH TERMOTECNOLOGIA SA. The empirical research started in the spring of 2006. Several group recalls were made, with the shop floor Operators, with Technicians, with the Middle Managers and with directors.

Senior Managers were interviewed about different ways of problem solving, and dilemmas experienced by employees, both in the beginning of the process and in the end.

The groups recall were conducted by the researcher, recorded on videotapes, written down, interpreted and analysed. The interviews were semi-structured with the support of an interview guide.

4.4.1 Collecting data

a) Field notes: these are a very important way to register not only the comments from the different actors in the process, but also the perceptions of the researcher about the process. Field notes were taken during factory visits and informal conversations with several organisational actors.

b) Observation technique: external observation in the field (organisations) focusing on the answers and behaviours of all the actors.

c) Group recall: the researcher invites groups of employees (Operators, Technicians and Managers) to make a session where they can share experiences and tell company histories about the everyday work. This is a way to get deeper information about the organisation and the relations between employees and Managers.

d) Interviews: the main goal was to collect individuals' opinion about the organisational innovation and change process that is being implemented in the organisation.

e) Questionnaire: (This questionnaire was a specific request from one of the organisations – EFACEC, Automação e Robótica – and applied to both of them) administered to the participants in the groups recall: 10 individuals in EFACEC and 14 individuals in BOSCH TERMOTECNOLOGIA SA, with a total of 24 respondents. The participants were distributed across various functional areas and job positions including Operators, engineers/Technicians (e.g., software systems, electrical, and project), Managers (e.g., project, marketing, process, and manufacturing), and directors (operations and marketing, production, software development).

f) Organisational actors' opinions and suggestions: handed in to the organisations and integrated in each organisation. It is a way to "validate" the research and create new knowledge in a process of collective reflection.

4.4.2 The AR process

In the empirical phase of this research, I will use Thiollent's phases (1997) to define the actions in the research process:

Exploratory phase – the researcher and the practitioners decide the need for an intervention, the actors involved and the possible type of action.

Deep research – the situation is analysed using different instruments of collecting data, discussed and interpreted by all of the participants through group recall and interviews.

Action phase – definition of goals that can be reached by concrete actions and presentation of proposals that can be negotiated between the participants (e.g. the innovation profiles proposed to help increase knowledge sharing).

Evaluation – organisation of a workshop on change where the results and reflections will be discussed and the knowledge produced in all the process will be disseminate.

The practitioners and the researchers learn to identify and solve questions and the learning process occurred in all the process.

In a practical way I have pursued the empirical approach mapping the contexts of the organisational innovation process; the perceptions of organisational actors about creating, using and sharing their individual knowledge; the roles and responsibilities of those involved expressed by all the organisational dilemmas defined, and the impacts of organisational innovation process in the organisation.

Finally, it is important to refer that the perspective adopted about what will be considered an organisational innovation is the one that points out that innovation is considered as a change, understood as new, for whoever adopts it (organisation or individuals). This perspective tends to characterize a novelty as innovation, depending on the perception of whoever adopts it (please see, "2.3.2 *Organisational Innovation and Change Framework*").

4.5. Conclusion

In conclusion, we can say that this research had a strong influenced by the potentials of the group recall technique. It was the main tool used to collect data, to understand the different perceptions of organisational actors through their shared experiences and an opportunity to participants interact and share their accumulated knowledge about the organisation processes of knowledge sharing.

However, the research was not only affected by the chosen method, but also by the researcher's role, namely, by the researcher's background experience, by the interaction with other organisational actors and by the reflection about the process.

This research suggests that group recall can work well – and in some cases better than any other method – but only in certain circumstances and in specific research. Group recall has appeared to be the most suited to a research that provides a space for organisational actors to share their common work experiences.

CHAPTER 5 – CREATING AND USING KNOWLEDGE IN ORGANISATIONAL INNOVATION AND CHANGE PROJECTS – THE CASE OF TWO PORTUGUESE ORGANISATIONS

5.1 Introduction

This chapter is the one in which the research undertaken is described and analysed. In this chapter the two organisations that have participate in this research – EFACEC, Automação e Robótica, SA e BOSCH TERMOTECNOLOGIA SA – are analysed according the five research dilemmas (see chapter one). We will give a detailed analysis of the group recall discussions and share the participant's knowledge about the organisation and the processes of knowledge management.

At the end of each analysis, we have the reflections about the field research in the organisation.

5.2 BOSCH TERMOTECNOLOGIA SA Organisational Innovation Project

"Innovation and change is a predominant factor in the management of organisations and if an organisation (...) is not growing, not changing, not meeting the current needs of society, and preparing to meet its future needs, it is declining" (Higgins and Vincze, 1986, p. 29). BOSCH TERMOTECNOLOGIA SA is one of the most representative organisations that are always changing, improving processes and practices. This is one of their main values that contribute to making this company a water heating manufacturing leader.

5.2.1 Action Research in BOSCH TERMOTECNOLOGIA SA

The data was collected using group recalls technique and factory visits. Group recalls were the primary data collection technique since these provided the richness and depth of data, particularly regarding actors' perspective in the use of their individual knowledge in the innovation process. The sessions were tape recorded for later analysis, always with the participant's explicit agreement. The content analysis of company documents provided data on more overt expressions of motivation and action. The company documents analysed were BPS (BOSCH Production System) principles and change programmes, newsletters, as well as more formal documents communicating purposes and activities sets.

Access to direct observations of company changes was limited to the factory visit. Further validation of the data was achieved by feeding researcher's interpretations back to the company for accuracy.

The group recalls focused on Managers, Technicians and Operators' perceptions about the creation, use and share of knowledge in the organisation.

5.2.2 Contexts of Organisational Innovation Process

BOSCH TERMOTECNOLOGIA SA is the European leader for water heating manufacturing. Located in the North of Portugal and having about 1000 employees, the company has produced a major turnaround in financial and business performance during the late 1990s and early 2000s and continues to do so. It is a private company with a big focus on technological innovation, being Bosch's worldwide competence centre for water heating.

The company produces gas water heaters and boilers, and has markets all over the world: North America (31%), South America (25%), Europe (43%), Africa/Middle East (28%), China (2%) and Australia/New Zealand (23%).

The business unit combines production with a very strong investment in product development and marketing strategies.

In the early 2000s, they implemented the Bosch Production System (BPS) with some principles that characterize the global strategy of the Business Unit:

- Integrated management of the value chain;
- Waste reduction in all processes;
- Make all the processes simpler, clear and more flexible;
- Involve all the employees in their daily work, in order to surpass customer's expectations and improve the company's profitability.

The global objectives and premises of the BPS strategy are: Organisation and Leadership, Order Fulfilment Process and Association between Competence, Involvement and Qualification.

a) The changes introduced in BOSCH TERMOTECNOLOGIA SA

Analysing the type of organisational innovation according to the OCDE (2002) definitions as expressed in the literature review (p.22), BOSCH TERMOTECNOLOGIA SA is working on:

First axis - restructuring production and efficiency processes, business re-engineering, flexible work arrangements, greater integration among functional lines, and decentralization.

Second axis - human resource management practices, flexible job design, employee involvement, and improving employees' skills.

Third axis - product/service quality-related practices, total quality management and improving coordination with customers/suppliers.

BOSCH TERMOTECNOLOGIA SA is implementing BPS – Bosch Production System – with a holistic approach through the optimization of not only partial processes and departments, but all course and organisational units, especially their teamwork. BPS implies a systematic implementation of a multitude of devices designed to contribute to the improvement of quality, costs and delivery.

The implementation of BPS is best described through a phase model beginning with preparation, then stabilization and finishing with reduction. It is the basis for every BPS-oriented project work whether in the reshaping of existing production lines, the planning of new lines or in the product creation process. The central idea of BPS is to develop and deliver the right part at the right time in the right amount and with the required quality.

BPS started with 5S and this philosophy was important to reshape work organisation model in BOSCH TERMOTECNOLOGIA SA. The main idea was to know what employees regularly needed in their daily work, what they only needed sporadically and what they didn't need at all.

The regularly needed objects should be as close as possible to the work area, and the ones that are not needed should be removed as quickly as possible.

Another principle was to label all processes and their expected outcomes wherever possible.

Above all, the fundamental requirement for the successful implementation of BPS is striving for constant improvement. Through Kaizen[3] implementation, the company began to "*change in small, though ambitious, but realistic steps*" (kaizen first principle).

BPS implies a constant vigilance and observation of BOSCH TERMOTECNOLOGIA SA environment. Where do they see forms of waste? Can the production, as well as the administration processes, be further improved?

These questions are never fully answered. They are always looking for new answers. BOSCH TERMOTECNOLOGIA SA employees consistently demonstrated creativity and innovation – activities that placed an emphasis on the ability to engage in continuous learning and a deep knowledge of the organisation.

b) *Nature of Organisational Innovation and Change*

The organisational innovation and change implemented can be described as Incremental (Imai, 1989) because they are always in a change process, improving the organisational processes and, at the same time, these processes of change are part of a larger strategic plan of making BOSCH TERMOTECNOLOGIA SA the market leader in several continents. Management is guiding the process and after a preparation phase they are now in the implementation phase, after which they will start the reinforcement of innovation and change phase in the organisation.

c) Roles and Responsibilities

The attitude of each particular Manager played a significant role in how the BPS and the continuous improvement programme is being implemented. It is seen as a responsibility of all Managers and workers. Across departments, the BPS has a big impact on everyday activities and the organisational actors assume different roles.

The Operators work in accordance to standards, within a specific work rhythm, and point out deviations immediately. They support problem analysis and elimination of the root cause of problem and are involved in regular improvement activities.

The team leader assumes daily leadership on the shop floor and makes quick response to deviations. He coordinates and supports sustainable problem solving and improvements.

[3] Melhoria contínua

The Department Manager defines targets, assuring communication and standards management. He is also responsible for defining and initiating improvement activities or projects.

The Plant Manager prepares the status meetings along the road map of change. According to the BPS's principle of continuing improvement, the new Manager's role is to manage and develop processes and people on a daily basis.

Only the behaviour of the leaders helps to create bigger employee involvement and attitudes that lead to a culture improvement.

d) *Origins of Organisational Innovation and Change*

The initial and more important source of organisational innovation and change is the Bosch Production System. Bosch extended BPS to all organisations of the group and their long-term perspective is focused on results, ensuring a clear and effective organisation supported by processes and leadership who encourages workers to take initiative.

BOSCH TERMOTECNOLOGIA SA CEO assumed a particular role in BPS implementation, creating a centre of competence and expertise. It had a special responsibility for transferring the know-how and enabling an environment for innovation.

It was the beginning of the creation of an innovation culture with workplaces characterized by high levels of functional flexibility, autonomy and interchange ability promoting innovative behaviours - including the generation of new ideas and the participation in their implementation.

In addition, the HR system provided a central mechanism by which BOSCH TERMOTECNOLOGIA SA managed a balance between promoting and rewarding worker innovation, while at the same time capturing the greatest possible share of the benefits of the innovation process.

Internal communication provides the mechanisms for the flow of information and knowledge between workers and between workers and Managers.

The BOSCH TERMOTECNOLOGIA SA knowledge management system is set to capture new ideas and promote the adoption of innovative ideas and their diffusion throughout the organisation.

Because Group BOSCH operates across national borders, it has a greater ability to leverage innovations learnt in one part of the business into other part of the business operating often in a different national context.

Finally, the costumers' influences in the heat water technology market also assumes an important role because they places pressure on product innovation and, consequently, on organisational innovation.

e) Barriers and Facilitators

The BPS was responsible for instigating major changes in the company, creating the Continuous Improvement Programme (CIP). The main goal was to make the company more efficient and optimize all the resources in order to improve the quality and the performance.

However, employees do not always have the same perceptions as the Managers and they do not always follow the same definitions or standards.

BOSCH TERMOTECNOLOGIA SA BPS Manager assumed that some times standards were simply not set or people did not follow them. There were also insufficient support from experts from the service departments and a large leadership ratio, which made personal coaching and a fluid communication among Managers and workers difficult.

Managers also confirmed that they had a poorly structured leadership around problem solving and target achievement, but they were developing strategies to overcome this kind of situations.

Even if they already had several problem solving routines, they need to be improved, and be more systematic and sustained.

The implementation of CIP needs to be more disseminated in order to help develop the innovation culture. At this time, small improvements get hardly any attention by Managers, but they assume a very important role in BOSCH TERMOTECNOLOGIA SA organisation.

5.2.3 Impacts of Organisational Innovation and Change

The focus on continuous improvement affects the organisation in several levels.

Table 10 – Impacts on Organisation

Organisational Actors	Traditional Production	Continuous Improvement
Team Leader	Dependent on the leader's personality	Structured problem solving
Team Members	Dependent on worker's personality	Standardized work
Leadership ratio	Large	Small
Problems	Not transparent due to inventory and possibility to work around standards	Transparent due to standards and automatic response systems
Structured communication	Daily meetings discussing results	Support for problem solving, problem oriented
Leadership on the shop floor	Irregular, event driven	Permanent
	Sporadic, project based	Triggered by deviations
Qualification training	Technical and social skills	Problem solving skills
Standards	Defined by experts, rarely confirmed by leaders	Developed together with associates, daily process confirmation.

The main impact involves leaders, Operators and several procedures in the organisation. The team leader focuses in structured problem solving and the team members on standardized work.

Another important impact is a small leadership ratio instead of a large one, as it was in traditional production. Problems become more transparent due to standards and they have support for problem solving situations. In the shop floor, the leadership is permanent and triggered by deviations.

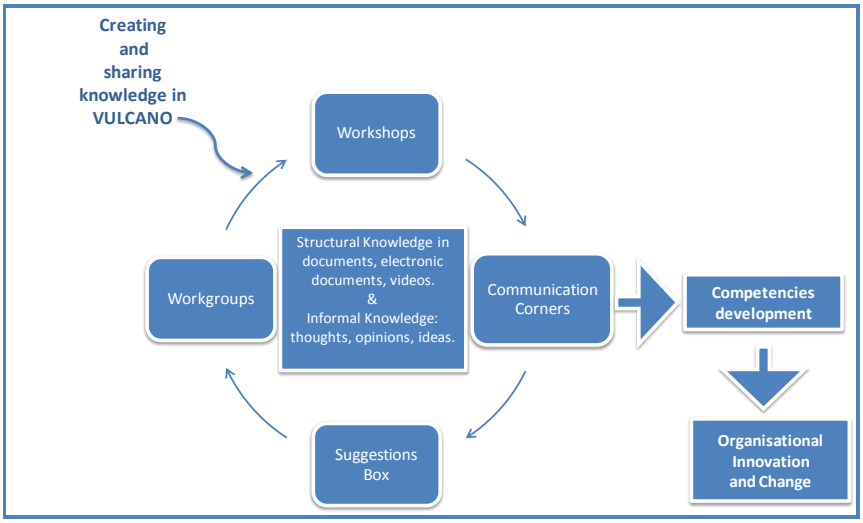
Training is more focuses in developing problem solving skills then technical and social skills.

Finally, standards are developed with the participation of workers on a daily basis.

5.2.4 Creating and sharing knowledge during Organisational Innovation Process

BOSCH TERMOTECNOLOGIA SA has several mechanisms for creating and sharing knowledge. Workshops, workgroups with workers from different sections and departments, suggestion boxes, and communication corners that are spaces for exchanging ideas, opinions and thoughts, but also to present structured knowledge through documentation, videos and other means.

Figure 8 – Creating and Sharing Knowledge in BOSCH TERMOTECNOLOGIA SA



Workshops are exceptional vehicles for bringing together employees from different areas to discuss an issue – i.e. a problem or the discussion of a new idea. These workshops can be scheduled on a regular basis during a period of time or they can be an isolated event set to share opinions and insights.

Sometimes it is necessary to invite outside speakers to these sessions. Agents who are in direct contact with customers, customers, specialists in some kind of area and other experts.

The invitation of customers for these workshops has an important role whenever BOSCH TERMOTECNOLOGIA SA is looking for new ideas or ways to improve products. It is an opportunity to share knowledge with people who do not know the technical aspects of the products, but can give important ideas about their functionalities, generating valuable shared insights.

Workgroups are created according to the needs of the organisation. Sometimes a well-defined problem statement is discussed, and the workgroup makes the necessary analysis and review, formulating recommendations for going forward.

At the moment, several workgroups of TPM (Total Production Management[4]) where created, to improve the efficiency of the machines. These workgroups are very important to improve efficiency in BOSCH TERMOTECNOLOGIA SA because Technicians undertake all the maintenance tasks, solving machine/equipment problems, while the Operators did not know how to assist them.

With TPM, company involves workers across the factory to ensure effective equipment operation in order to prevent breakdowns. TPM affects areas such as overall equipment effectiveness, total process reliability and total quality management and it's a process that requires the commitment from all the workers and Managers.

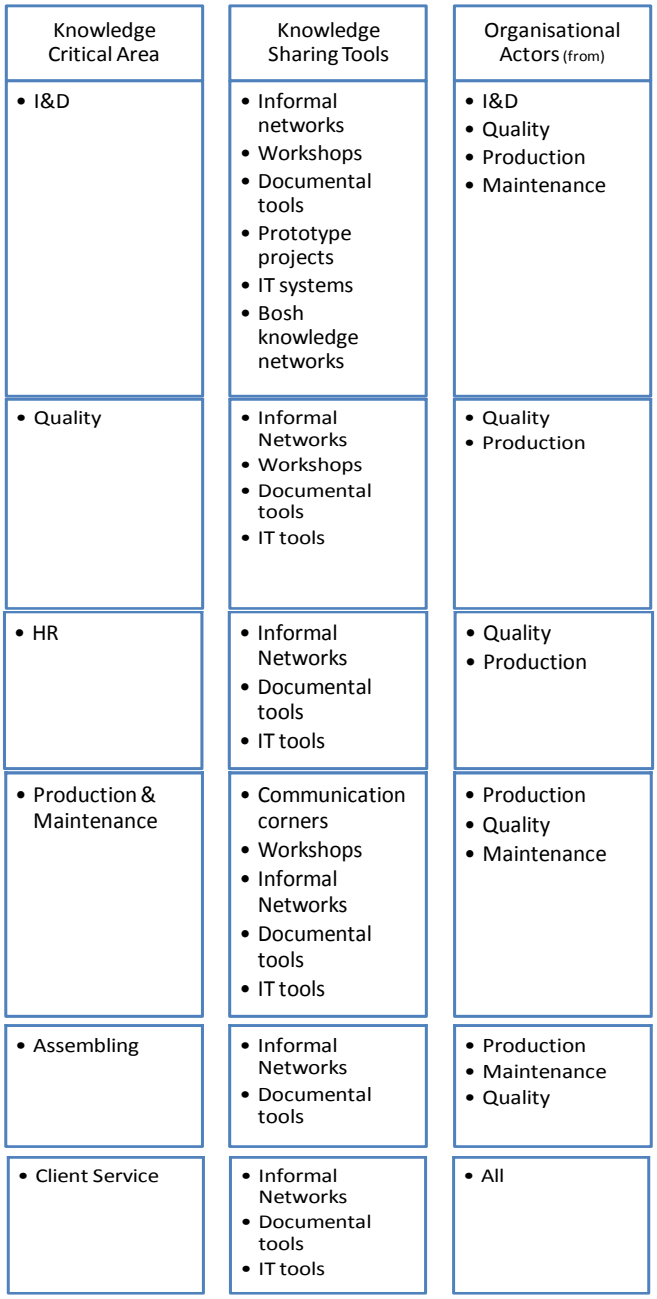
Workgroups are also established for strategy development and setting future directions. Cross-functional projects, training and program launches provide other ways to create workgroups and the share knowledge.

Another, but less standard, mechanism for sharing knowledge are the communication corners. A simple 30-minute weekly meeting or a random meting when some kind of situation occurs can be invaluable. The idea is to jointly look at the operating results and discuss them, trying to understand them and finding new processes to reduce time or costs.

In these communication corners, BOSCH TERMOTECNOLOGIA SA has operating data exhibits focusing on results and operating issues. This facilitates knowledge sharing across the company. All areas present their key operating results, creating a healthy challenge because the results are associated to an annual reward for the best team.

[4] TPM is a methodology used to optimize production, reducing lost and maximizing equipments and machines use.

Figure 9 – Sharing Knowledge: Actors and Tools by Knowledge Critical Area



Knowledge Critical Area	Knowledge Sharing Tools	Organisational Actors (from)
• I&D	• Informal networks • Workshops • Documental tools • Prototype projects • IT systems • Bosh knowledge networks	• I&D • Quality • Production • Maintenance
• Quality	• Informal Networks • Workshops • Documental tools • IT tools	• Quality • Production
• HR	• Informal Networks • Documental tools • IT tools	• Quality • Production
• Production & Maintenance	• Communication corners • Workshops • Informal Networks • Documental tools • IT tools	• Production • Quality • Maintenance
• Assembling	• Informal Networks • Documental tools	• Production • Maintenance • Quality
• Client Service	• Informal Networks • Documental tools • IT tools	• All

5.2.5 Knowledge Dilemmas in BOSCH TERMOTECNOLOGIA SA – actors' perceptions

5.2.5.1 Perceptions about BPS (Bosch Production System)

To understand BOSCH TERMOTECNOLOGIA SA processes of organisational innovation and change, it became important to find out what each hierarchical level in the organisation thought about the meaning of BPS.

Department Managers (Engineering; Production; Human Resources-Training) said "BPS is a new philosophy of work. We think that it is a major change in employees' mentalities. We were not prepared for high production lines, we had little flexibility and BPS brings simple solutions for easy change, and easy ways to adjust our production processes. The BPS allows lining up the tools that existed before BPS, because we already used very efficient production processes, but we needed this change of mentality".

They also said "it was also important to have a common name at group BOSCH level. It is the line master for everyone working at BOSCH organisation. It helped to create principles and work procedures that are the same throughout the group."

According to Middle Managers (Quality; Final Lines; Internal Components) BPS is "a common name in BOSCH group that is associated to some principles that help us to see things in a different and integrated form. BPS is a change of mentality through communication and involvement of the employees".

Production Managers see BPS as a way to create standards, routines and work procedures.

For Technicians, BPS is "a way for the entire group to work the same way". All workers assumed the same mentality, and follow the same work routines and procedures.

One of the Technicians said "change process has already begun in BOSCH TERMOTECNOLOGIA SA with 5 S programs (before BPS implementation). When BPS started we had several communications and information about it, but I don't know if the workers had the notion of all the implications".

At the beginning, workers thought that they had to memorize BPS principles. But "in my opinion, it is not necessary to memorize them. The more important is that workers

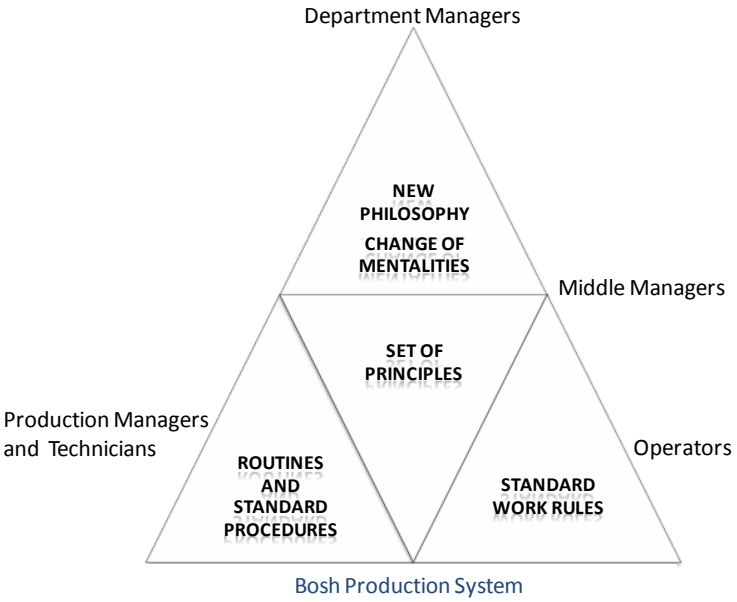
understand the concept and have the necessary work conditions to follow the BPS principles".

“Today I think that we have taught the workers, specially the Operators, to follow those principles. Knowing how to apply the BPS principles is more important than memorizing them."

According to the Operators, “BPS is a tool to improve the work methods, to reduce the costs of the work and to obtain work norms that are *standard* for all the company.”

Analysing the Managers and employees assumptions about BPS, we can identify different perspectives. Departments and Middle Managers see BPS as a new philosophy, a change of mentalities through a set of principles that guide behaviours and the strategic orientations of the company; Production Managers and Technicians relate to the factory work and refer that BPS represent standard procedures and routines, just like Operators refer that it also represents work rules.

Figure 10 – BOSCH TERMOTECNOLOGIA SA Managers and Employees perceptions about BPS



All the documentation consulted point out that BPS is an attempt to get a set of standards and to have a real production system throughout the organisation.

In the past, each division implemented these approaches on their own, but now the approach is to get a production system with a common set of standards and to create synergies between factories.

The aim of BPS is to increase customer satisfaction and value contribution through overall improvement of quality, delivery and costs.

5.2.5.2 1st Dilemma

"Literature emerges the idea that the use of individual knowledge accumulated through life and professional experiences is a competitive advantage for the organisations' success. However, sharing and transferring inexpressible knowledge is almost an impossible task to accomplish."

Knowledge can be categorized into explicit and tacit knowledge (Nonaka & Takeuchi 1995; Johannessen et al., 2001, p. 4). Both categories are, by nature, extremely difficult the transfer, not only because tacit knowledge is, in some extent, embodied in human brains, but also because explicit knowledge is embedded in organisational routines, practices and contexts.

According to their nature, tacit and explicit knowledge possess completely different characteristics and are shared in completely different ways, needing different kinds of competencies for its effective transfer and share. Explicit knowledge is regarded as objective, free from individual subjectivity, while tacit knowledge is highly subjective, being embedded within the cultural values and assumptions of those who possess and use it.

Several researchers affirm that knowledge share requires extensive and direct social interactions between people, as it is only during such processes that the tacit component of knowledge can be shared. The most important researchers in this field are Nonaka and Takeuchi (1995) that they have both crystallized the idea of the interaction of tacit and explicit knowledge, and how it leads to the creation of new knowledge, in their "knowledge spiral".

Next, we will discuss forms of interaction to share tacit and explicit knowledge in BOSCH TERMOTECNOLOGIA SA supported by the base idea of Nonaka and Takeuchi's Knowledge Spiral. However, we will not use the categorization of the model because we think that the processes of creation and use/share of knowledge cannot be separated. It is a dynamic process that blends all forms of knowledge share.

a) Knowledge sharing and transference in the factory

Transferring tacit knowledge requires specific competences of interaction because it represents knowledge that people possess, but which is inexpressible and incorporates both physical skills and cognitive frameworks.

In BOSCH TERMOTECNOLOGIA SA, the transfer of knowledge between Operators is based on long years of experience, especially when new workers arrive to the factory. This knowledge is shared through an extensive amount of social interaction and face-to-face communication.

> "We have some concerns about knowledge sharing and transference, especially because of new workers. This is normally temporary workers, and we have some routines for their integration. The more important is the coaching process that occurs with an older worker that knows the factory very well and all the work procedures, and helps the new workers in an informal way in the first weeks, showing them what to do. (Group recall – Production Managers)

"Our main problems with the new temporary workers are because they have a contract for a little period of time, and sometimes they do not have the necessary commitment to learn all our procedures and implement them with accuracy." Technician from Methods and Times Section

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To make this process of knowledge transfer work and to make the sharing effective, since BPS implementation BOSCH TERMOTECNOLOGIA SA has been promoting a trustworthy atmosphere among workers and among them and the Managers, making workers more participative and more involved.

> "The shift supervisor participates in the integration of new workers, helping with the coaching process. When some doubts arise, the new workers consult the colleagues and the supervisors of that section". (Group recall – Production Managers)

This interaction among workers and Managers are also important when they try to share and transfer explicit knowledge, because of the inherent ambiguity of language and because people have different cognitive frameworks, creating scope for differing interpretations.

Tsoukas (1996) gives validity to this idea when he suggests that tacit knowledge and explicit knowledge are inseparable and are mutually interconnected. Without an (tacit) understanding of the language in which explicit knowledge is written or the grammar and syntax used to structure it, any text will appear as a somewhat random series of

letters, numbers and images. Thus, there is no such thing as fully explicit knowledge as all knowledge is ‘either tacit or rooted in tacit knowledge’ (Polanyi, 1969, p. 195). Alternatively, to state it succinctly, ‘all knowledge has tacit dimensions’ (Leonard and Sensiper, 1998, p. 113).

In this context, the coaching process assumes here a critical role because no matter how explicit and well defined the rules and routines are, there will always be some element of ambiguity or uncertainty creating a need for analysis and comprehension.

After all, ‘knowing’ and ‘doing’ are two inseparable processes, and knowledge development occurs on an ongoing basis through the routine activities that workers undertake.

In BOSCH TERMOTECNOLOGIA SA, these ideas can be illustrated through the process of applying Operator’s knowledge with the help of the Technicians together with experimentation, observation and dialogue techniques, which allow the adaptation of existing knowledge to new and novel situations.

This represents an important and undervalued source of learning in the factory, and the processes of learning by observing are crucial for the new workers. They learn through socialization, observation and practice.

> “Our instruction sheets of operating procedures and competencies tables represent a form of explicit knowledge in the plant, which can be used by the workers. But first they need to learn with the older workers or even the shift Managers how to use our work routines.” (Group recall – Production Managers)

To share more objective knowledge like rules, procedures and routines, BOSCH TERMOTECNOLOGIA SA uses several techniques:

> “We created a procedure sheet that new workers should follow.” (Group recall – Production Managers)

Knowledge transference is often based on the organisation’s explicit knowledge, in this case procedures sheets. However, they also have knowledge databases for quality problems, and solutions and others repositories where they store information and documents that can be reused and shared like, for example, product specifications, manuals, and other information regarding production.

In each section of the factory there is a computer where it is possible to search the databases, but even if it could be possible to use information technology for partial

transference of explicit knowledge, without the tacit elements that underpin it, it will be impossible to develop a full understanding of what this knowledge means.

Contemporary literature is consensual about the fact that the sharing of tacit knowledge via information technology systems is extremely difficult, if not impossible, to achieve.

b) Understanding explicit knowledge in the factory

One of BOSCH TERMOTECNOLOGIA SA's management main concerns is to store and codify rules and procedures in simple format so that employees can easily access and understand them. If rules and procedures are not stored and written clearly, each employee is likely to follow his/her own interpretation of the rules. When rules and procedures are clearly marked down, there is far less ambiguity in understanding and interpreting those rules and procedures. The BPS process of automation and standardization of tasks and schedules is a way to handle this situation.

Despite all information displayed in the plant to help workers to develop their work more easily and with higher productivity, BOSCH TERMOTECNOLOGIA SA has to face a problem situation, explained by Technicians:

> "Today we have a problem. We depend on the workers understand of the information displayed in the sections and how that information is given by the Managers and Technicians. Sometimes Technicians use a very complex language that creates an obstacle to workers' understanding. They use words that workers don´t understand creating confusion and rumours in the plant.
>
> If the information was more clear and the communication more simple, rumours would diminish and the Operators would be more aware of their contribution for the global productivity.
>
> We don't have a lack of information, but it should appear in a simpler form." (Group recall – Technicians)

"Some of our colleagues are afraid to ask for help to understand the chart information, because they don't want us to think that they can't read it." Technician from Methods and Times Section

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Production Managers have a different understanding, based in workers qualifications. Different levels of understanding seam to coexist in BOSCH TERMOTECNOLOGIA SA's plant according to workers qualifications.

> "We have workers with very low qualifications and they cannot understand the information displayed in each section, even if we explain it continuously. Although we use a colour system to facilitate the understanding, sometimes workers ask "why are we red?" but they do not make any reading of the data." (Group recall – Production Managers)

Operators also referred the few qualifications of the Operators as an obstacle to understanding the information displayed. However, some of the Operators had a very clear idea about the data displayed in the plant and also an explication about the few interest of their colleagues in looking for that figure with more attention.

> "The information displayed in the plant is information difficult to analyse because we do not have enough qualifications to interpret the data. They should present the data in a simpler way, showing clearly the differences between the teams. Perhaps this was a way to make Operators understand that kind of data. It would be important to perceive where are production oscillations, the state of company, and the state of each section, according to defined production goals.
>
> However, it is not enough to display this kind of information in the plant, because the Operator's do not have the time to look at it. We have very tight schedules and we pass through it running without any time to analyze the pictures displayed in the plant." (Group recall – Operators)

"In the morning we come in a hurry so that we're not late and in the end of the shift we want to go home, so we don't have much time to look at the charts." Operator from Production

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Department Managers showed interest in overcome that situation, investing in communication preparation using more easy formats that will facilitate the process of understanding. However, they are aware of the fact that not all the workers will understand it:

> "Some employee asks for explanations about the information exposed in communication corners. Some of them try to understand the information with their colleagues and other with the Manager shift." (Group recall – Department Managers)

Middle Managers also assume that not all workers understand the information displayed in each section.

> "Many employees from the production area don't understand the information that is displayed. This information is related with the productivity and with other production

indicators. Some of the information is displayed in charts with colours, to facilitate their understanding by the employees.

However, some of them do not understand but ask for explanations to colleagues or Managers and some of them are afraid to show that they do not understand the information, so they don't ask for any explanation. We also have others workers that don't understand and don't care to know what that the information represents." (Group recall – Middle Managers)

Department Managers refer that this is a process of continuous learning underline the fact that they have invested a lot in Visual Management, trying to create in the workers the will to know more about that information and to understand the impact of their work in the factory's productivity.

"Visual management is not easy to understand at first sight for all the workers, but each time more and more workers become aware of the importance of those figures for their own work. (Group recall – Department Managers)

Middle Managers also underline the importance of Managers in informing the employees about what is happening and about the changes that are going on and to be carried through in the future.

"Communication is not only placed in placards, which inside the company is a normal practice, but it is also normal to make small meetings and discuss problems when they occur."

"The information is transmitted verbally by the Managers and supervisors in a very simple format. For example, in my section, whenever we import a TPM project for a machine, we have continuous training, so workers can understand and assimilate the knowledge. On the other hand, the information placed in communication corners is standard, displaying only differences in the results of each section." (Group recall – Middle Managers)

To overcome this kind of problem, BOSCH TERMOTECNOLOGIA SA invests in project management implementation. Workers of all the sections participate in specific projects and problem-solving situations. These processes will help the workers to develop their competencies and sphere of knowledge.

"At this moment, we are trying to solve this kind of situation with training. We know that workers find it hard because we have so many changes and always new things to implement and it is hard to assimilate all, but we notice that the workers who have

participated in the new projects, have a new understanding of things and are more open to share and learn.

On the other hand, the workers that have no participation in the new projects have more difficulties. We are trying to involve more Operators in all these projects, but sometimes it is not as easy as we thought at first. It's important that some of the Operators that already participated in it talk to others in an informal way, passing them some motivation to be more participative." (Group recall – Production Managers)

c) Transforming tacit in explicit knowledge

Explicit knowledge can be expressed in formal and systematic language, and shared in the form of data, specifications and manuals. Tacit knowledge is rooted in actions, procedures, routines and values. These characteristics make it easier to communicate explicit dimensions of knowledge than the tacit knowledge.

In many situations, tacit knowledge cannot be wholly converted into explicit. For instance, life and work experiences and all the knowledge those workers develop and store along the years. It seems to be easier to share technical knowledge, because it is already explicit in manuals and it is easier to explain, then organisational knowledge, that was accumulated along the years by the workers through work practices and routines.

"The technical individual knowledge is easier to transmit then managing principles. The procedures of some areas are already explicit. Nevertheless, it is not possible to transmit all the knowledge that we have. It is rooted in our experiences." (Group recall – Department Managers)

Department Managers focus that BOSCH TERMOTECNOLOGIA SA has that problem when one worker is leaving within the organisation. They know that it is possible to share a percentage of all the knowledge rooted in workers. However, it is not possible to share all of it.

"In situations where worker are leaving the company, we defined a period of time for them to work overlapped to transmit the knowledge to another colleague." (Group recall – Department Managers)

"It's important to say that even when a very valuable colleague is leaving the company we have a culture of transmitting the information among us. This is a special company where we like to work and have a good work environment." Technician from Methods and Times Section

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The major challenge of the organisation is to achieve balance between the tacit knowledge developed by individuals and the explicit knowledge needed for effective communication and integration. This is especially important to prevent workers from leaving the organisation with individual critical knowledge that was not explicited in any way within the company.

Individual knowledge is very important and if we cannot systematize it, it will be lost. After transforming tacit knowledge into explicit knowledge, it needs to be codified so it can be reused.

But how can we make it explicit? Davenport and Prusak (1998) stated that the transfer of knowledge can be made by formalized transfer mechanisms and informal exchanges. The formalized transfer methods include documents, databases, Intranets and GroupWare. Informal exchanges refer to the more casual events that usually take place face to face such as a conversation.

BOSCH TERMOTECNOLOGIA SA main ways of making the knowledge explicit:

- Written: through e-mails, documents and discussion groups.

  "All the procedures are available through documentation and in the intranet. Workers can access computers in each section to consult the information or ask the section's Manager to access the information for him, because some Operators do not know how to access the intranet and make the search or even how to use the computer" (Group recall – Technicians)

- Visual: using models, illustrations or data visualization tools.

  "The information is all registered in photographs and displayed in the sections' placards. The same happens with instructions, work plans, maps and tables, so that they are easier to read and understand." (Group recall – Technicians)

  BOSCH TERMOTECNOLOGIA SA takes photographs when they are going to make some changes in the plant and then they display them in the plant showing how it was before and how it is now. This very powerful technique helps to involve the workers in the organisation and in their work. They create emotional liaisons to their workstations, when they analyse all the changes that they have faced and overcome.

  Production Managers also referred other kind of information displayed:

"In the communication corners we place all the important information: efficiency levels, competencies matrix, instructions and productivity data." (Group recall – Production Managers)

- Spoken word: through voice mail, recordings, the telephone or person-to-person interaction.

"Communication corners are used for meetings. In some sections, the meetings are held weekly, with the goal to analyse all the issues that occurred in the previous week. With this we look forward to eliminate "Mr. Rumour" and involve the workers in all the factory situations and problems." (Group recall – Production Managers)

- Video/ observation: video databases, body language, master-apprentice relationship, video conferencing.

"For instance, we have problems and solutions databases and quality databases that are accessible to all workers, in each section of the plant." (Group recall – Production Managers)

- Combination: technologies adopted that include some or all of the previous.

"When we have problems we register them in an internal tool together with all the information related to the problems." (Group recall – Technicians)

Individual knowledge, if not shared with others, will have very little or none effect on the organisation. Therefore, one of the important tasks for organisations is to facilitate the process of interaction between employees promoting and encouraging the use/share as well as using the knowledge gained and stored in the form of explicit knowledge. This will be explored in the next following dilemmas.

5.2.5.3 2nd Dilemma

"The use and share of employees' individual knowledge is an important factor to solve problems and strengthen performance. However, several organisational and individual barriers condition the process."

a) Mapping the most important knowledge and competencies for the organisation

Competencies include the necessary elements (combination of knowledge, skills, and attributes) for achieving important results in a specific job or work role in a particular organisation.

Competencies tend to fall into two categories: behavioural competencies that include factors not tied to a specific work function or industry (often focusing on leadership or emotional intelligence behaviour) and functional or technical competencies that include specific factors within a given work function or industry.

These competencies can be mapped in a list that represents the most critical factors in specific functions, departments, organisations, or industries.

BOSCH TERMOTECNOLOGIA SA uses competencies' maps as an important tool of management in each section of the plant. Production Managers referred that:

> "We have competencies maps in each section that express Operators' qualifications and competencies. We have simple workplaces; workplaces with control; workplaces with sensible equipment; and workplace with final line tester. Mapping competencies are important because we can rotate the workers and make substitutions if a worker doesn't show up to work one day. (Group recall – Production Managers)

These maps help the section Managers to organize people's work and activities, putting the best worker in the most adequate workplace according to his competencies and qualifications. Middle Managers also reinforce the importance of mapping competencies:

> "We have a competencies' matrix that helps us manage the employees in the several sections of the plant." (Group recall – Middle Managers)

"If I am ill and need to stay at home, my Manager knows immediately which one of my colleagues has the necessary competencies to do my work." Operator from Production

---

Production Managers develop this idea arguing that BOSCH TERMOTECNOLOGIA SA promotes flexibility.

> "We don't have workers in fixed workplaces, because the work is routinized and this mobility is necessary to increase the workers' motivation." (Group recall – Production Managers)

Regarding BPS goals, Managers motivate workers to change workplace, stimulating job rotation, but with concerns about productivity and quality. This is a way for workers to create work habits and learn new methods of work.

> "We considered job rotation a way of learning." (Group recall – Production Managers)

"Here we don't stay in one workstation for a very long time. This is important because we can learn how to do different things." Operator from Production

---

However, not all the workers seam to face this rotation as a positive thing and sometimes some resistance can emerge.

> "Some of our workers' first instinct is to say that they don't know how do accomplish that operation, but the Shift manager coaches them and quickly they acquire the necessary competencies to develop the work." (Group recall – Production Managers)

Using coaching techniques, Shift Managers can eliminate some of the resistance, but not from all workers. Some of them only know how to do specific activities - they have stopped in time and if they are moved, this creates a negative impact in their productivity.

> "Some workers who do the same operations every day, with 70% of productivity, if they are sent to another workplace their productivity goes down to 50%." (Group recall – Production Managers)

b) Who are the carriers of valuable and scarce knowledge?

In every organisation several workers can be identified as the knowledgeable, the ones who have the critical competencies.

However, organisations are not always aware of the importance of its employees' skills. They are often not able to adequately identify skill strengths and weaknesses at organisational and team level. BOSCH TERMOTECNOLOGIA SA soon realised that being a market leader meant they had to created tools to help them measure and develop employees' skills and capabilities in a more effective way. The importance of having multi-skilled teams and at the same times several employees with specific skills, helps them organize production without stops because absenteeism (employee illness, training sessions, or other) is a major concern for Middle Managers.

> "We are interested in having multiskilled teams with people with a large spectrum of competencies. This will allow us to be more flexibility and to make any necessary substitution in several tasks when needed. This is defined for the majority of important tasks. At least we have two employees prepared for critical tasks." (Group recall – Middle Managers)

To acknowledge who had what kind of competencies, BOSCH TERMOTECNOLOGIA SA created a table of competencies where they map employee's skills. This was achieved after careful job analysis and using job description techniques, allowing BOSCH TERMOTECNOLOGIA SA to build up a map of the different skills needed to complete various tasks associated with a specific function.

These tables of competencies express the Operators' qualifications in each section. The workplaces are classified as:

- Simple Workplace
- Workplace with control
- Workplace with sensible equipment
- Workplace with final line tester

BOSCH TERMOTECNOLOGIA SA maps individual competencies in a competencies' table and affix them in every section according to the type of workplace. They also use the information present in the competencies' table to create a training matrix that is always changing because of new training needs.

> "We have a competencies' matrix that helps us to manage the employees in the several sections of the plant. (Group recall – Department Managers)

Each workplace has critical competencies and one level of autonomy associated, in what concerns the decision-making and problem resolution.

> "In production we have a competencies' table where everyone's competencies are identified."

> "In critical activities as maintenance, we have always defined who can replace each worker. However, it is not guaranteed that the person replacing another can maintain the same level of performance than the person who normally performs these functions." (Group recall – Middle Managers)

To facilitate the work, they have lists of Operators related to the critical competencies, and the machines.

> "In each workstation we have a list of Operators that can develop the associated tasks and a list of Operators who can operate the machine.
>
> These Operators have had training in the specific requirements of that workstation and when a new worker is recruited he has to be trained so that he can develop his skills operating that machine." (Group recall – Technicians)

The information in these tables is also used in the performance management appraisal to assess employees' performance and to promote flexibility in the plant.

> "In BOSCH TERMOTECNOLOGIA SA we promote flexibility. We don't have workers in fixed workplaces because the work is routinized and this mobility is necessary to increase the workers' motivation.
>
> The Managers motivate the employees to change workplace. We stimulate job rotation, but with are concerned about productivity, quality and the goals defined." (Group recall – Production Managers)

These instruments of knowledge management help Managers in a very practical way to manage their subordinates and their individual knowledge. Middle Managers have reinforced this idea when they said:

> "The Manager must develop these competencies in the employees and know the ones that are more able to take on more responsibilities." (Group recall – Middle Managers)

Production Managers also considered job rotation allowed by competencies tables a way of learning, because employees can have their sphere of competencies widened.

> "We often change workplaces because we don't want workers to develop work habits, and in order for them to learn new methods of work. We considered this a way of learning." (Group recall – Production Managers)

However, the use of individual knowledge and the full participation in BOSCH TERMOTECNOLOGIA SA organisational life is also influenced by the employees' characteristics, and Middle Managers have distinguished three types of employees:

> "We have very different employees in BOSCH TERMOTECNOLOGIA SA and it is not very easy to manage all of them using the same techniques. We have:
>
> 1. Those that want to succeed on their own;
>
> 2. Those that don't want to succeed and don't care about it;

3. Those that would like to succeed, but do not have the right profile or ability. These employees cannot follow the innovation and change process because they do not possess the necessary characteristics to develop themselves." (Group recall – Middle Managers)

It is important to point out that BOSCH TERMOTECNOLOGIA SA has two generations of employees. One group is formed of young employees and the other group is formed of older employees that started working at BOSCH TERMOTECNOLOGIA SA for more than twenty years ago. The oldest employees are, on average, 45 years old and because they lack training, their qualifications are very low. The other group has younger employees that possess more qualifications and are more easily able to learn and work in a change environment. The majority of people from this last group is, therefore, more open to accept BPS challenges than the older employees.

During the group recall sessions, Middle Managers showed their concerns about the importance of qualifying employees giving them more competencies, since BOSCH TERMOTECNOLOGIA SA works with several types of technologies that need employees' expertise to work with very high quality standards.

> "We invest a lot in skills' development because the employees who have very little qualifications have more difficulty to follow the technical evolution and their learning capacity is lesser and this has consequences on the final product." (Group recall – Middle Managers)

"I have studied here to be more qualified and to have a certificate. This was very important for my professional life because it helped me to develop other kind of tasks, more complex." Technician from Methods and Times Section

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Even if knowledge is considered highly personal and in the work practice usually informal (and some times even invisible), it can effectively increase organisational performance and product quality. BOSCH TERMOTECNOLOGIA SA Managers work in the plant side by side with employees because they learned that some of the employees' attitude for knowledge sharing can be used to show other more resistant employees how to change production practices and improve productivity at the same time.

> "We work very closely to the Operators and know all their competencies, potentialities and weaknesses. We know where each worker can be more productive and know which ones are more open to change."
>
> "However, some employees resist to each change introduced in their workplace. Their first instinct is to say: 'I don't know how to accomplish that operation', but the Shift Manager coaches them and they quickly acquire the necessary competencies to develop the new tasks." (Group recall – Production Managers)

The oldest employees find it harder to follow all of BPS changes. Middle Managers said:

> "Some of our oldest workers stopped in time. They only know how to work in their workplace, doing the same operations every day. We measure their productivity up to 70% doing the same routines every day, but if we changed them into another workplace, their productivity would go down to 50%." (Group recall – Middle Managers)

Production Managers consider that this is a cultural problem because the oldest workers have rooted habits that condition adaptation to the change of new processes and technologies and the youngest workers are more open to change and to the use of new technologies.

Nevertheless, Production Managers also have problems with younger workers because some of them show no commitment because they are too young to handle greater responsibilities – the day-by-day coaching process is intended to give them work orientations and to develop work rules and routines.

> "Even some of the youngest are not committed because they don't have responsibilities in their personal life and that makes them not as committed as they should be. The great challenge is the change, not the technical change, but behavioural change." (Group recall – Middle Managers)

c) Using and sharing knowledge to help the organisation respond to challenges

To share knowledge workers need to work together, facilitating the exchange of their knowledge and enhancing organisational learning.

Workers share knowledge when they talk to their colleagues to help them get something done better or more efficiently.

> "When a new worker arrives to BOSCH TERMOTECNOLOGIA SA, if he faces a problem, depending on its degree of complexity, he consult his colleagues or the shift supervisor or the section Manager.

> If the new collaborator is working in a critical workstation he is integrated by a higher qualified Operator and if some problem occurs he can consult a colleague or any authorized person already defined for that specific workstation." (Group recall – Technicians)

On the other hand, the experience-based knowledge that resides within the organisation can be captured, organized, reused, and transferred in order to make it available to others.

> "We have pictures with work information throughout the plant, and workers can resort to them whenever they need to. However, some Operator's don't consult this information. We have tried to create this as a routine, but we still have a long way to go in this area. Operators need to understand the importance of documents and receive adequate training in their consultation and analysis.
>
> When new projects are being implemented, it is necessary to involve the Operators and to question them: 'What do you know about this?', 'What does this mean?', 'Please consult that documentation…'
>
> We have standards that are explained to Operators during training sessions, and we have an evaluation process that verifies if the Operator is following the standards and what we have defined during the training sessions. The goal of this evaluation is to verify if the Operator has the skills and the competencies to develop that kind of work.
>
> The main idea is that someone who does not belong to the organisation can understand the Operator procedures and tasks only by reading the procedure description on the workstation sheet.
>
> Understanding why is important to execute all workstation tasks following the defined standards is very important because it is easier to reach a higher performance and if a new Operator is recruited, his integration is much easier." (Group recall – Technicians)

Knowledge sharing can offer an organisation the potential for increased productivity or efficiency. Pascarella (1997) refers that knowledge could steadily increase corporate assets, such as management systems, brand identity, customer information and corporate reputation.

d) Using knowledge in problem solving

Problem solving is aided by the quality and availability of the knowledge used to handle situations. According to Wiig, it helps to "decide what to do, innovate, act and evaluate the implications of approaches and action" (2003, p. 1).

> "BOSCH TERMOTECNOLOGIA SA has a good system of problems resolution. It is part of the BPS and the new methodology of work." (Group recall – Middle Managers)

> "Workers have autonomy to solve less complex problems, and problems and solutions are register in a database that can be consulted when a problem occurs, facilitating the use of knowledge." (Group recall – Department Managers)

Workers have an important role in problem solving situations. Their individual knowledge is the critical factor to identify the problem and the possible solutions. Production Managers who work directly with the workers have identified workers with two different attitudes:

> "a) Workers that don't show any concern about the problems.
>
> b) Workers that try to help in an individual bases and when they can't solve the problem, they communicate it to the shift Manager." (Group recall – Production Managers)

BOSCH TERMOTECNOLOGIA SA uses temporary workers when necessary and when the contract of some of these workers is near its end, they assume a contentious attitude and do not show any concern for the quality, the achievement of production goals or for the product quality. However, it seems that most part of workers has a strong link to BOSCH TERMOTECNOLOGIA SA showing involvement and participating in BPS implementation.

Nevertheless, it is easier for workers to try to solve technical problems then organisational ones:

> "Some problems are mere anomalies that employees can identify and they have an easy solution, especially when we are dealing with technical problems, and not with organisational ones (for these they don't have the necessary knowledge). This has been an everyday battle, with systematic procedures thought to make all the employees involved." (Group recall – Production Managers)

Most part of the knowledge in organisations is *dynamic* because it is concentrated on workers, but some of that knowledge is *static* (documental information, for example). It is essential that the dynamic knowledge can be stored in repositories which over a period of time will become a substantial source of relevant information and expertise.

> "Each workplace has one level of autonomy associated, in respect to decision making and problem resolution." (Group recall – Production Managers)

"If I have a simple problem in my machine, normally I know how to fix it. It is only when the problem seems to be very complex that I consult my shift Manager" Operator from Production

Knowledge can be a criterion for autonomy and decision-making. The more knowledgeable workers are, the more potential they have and the more autonomous they can be, unlike other workers that are less knowledgeable. When the worker's range of knowledge is wider, his contribution is greater and he is in a position to make some kind of technical decision.

> "It is possible to seek a description of the problem's resolution, and access a set of quality tools: analysis, diagnosis, information and research." (Group recall – Middle Managers)

During the workday, workers face several problems and they solve most of them in an unconsciously (in a tacit way), automatically and in a few seconds. Other situations require more time, effort, teamwork and collaboration. Situations can vary widely: some are well known and require routine, even automated knowledge, while others are more complex and require extensive abstract knowledge.

> "In BOSCH TERMOTECNOLOGIA SA when there is a problem, we have some technical procedures that we have to follow. If it is a simple problem that the Operator knows how to solve, he can do it alone. If he cannot discover a solution, he then informs the Team Manager and together they try to find a solution. If it is a very complex problem, a team with several Operators and Technicians is created to analyze the problem. The Operator that finds the problem also participates in this team that meets one time per week to decide the situations that appear and to define the corrective solutions." *(*Group recall – Department Managers*)*

> "We have problems that can be easily solved and others that are more difficult, but we have procedures defined for each of them." (Group recall – Middle Managers)

It is important to point out the alignment of perception in every hierarchical position according to problem resolution procedures. During Technicians group recall, they described an identical procedure or routine when a problem occurs to Department Managers and Middle Managers. They said that when a problem emerges:

> "Depending on the complexity of the workstation, the Operator decides if he has the knowledge and the tools to solve the problem by himself or if he needs help from the shift Manager. If the problem is too complex, he does not have the autonomy to decide the solution to the problem and then he informs the Shift Manager that evaluates the

type of problem, like if it is a quality problem or if it assumes some other form." (Group recall – Technicians)

Operators also have a similar perception of problem resolution:

> "If it is a problem in a machine, the evaluation is made by me. I have autonomy to make the first evaluation. If the problem is very complex, we have an internal system that initiates with an intervention order send to maintenance and it is also communicated to the shift Manager."
>
> "If it is a quality problem, all the production stops and we quickly analyse the problem, trying to identify the phase where it has initiated. Sometimes the problem started in the previous shift."
>
> "In the Welding section the procedures are the same: we analyse the problem and if we can, we solve it. The remaining problems are registered in proper documentation." (Group recall – Operators)

Using Piaget's (1966) distinction of problem types as either routine or non-routine, Billett (1998) identified routine problems as the ones "requiring individuals to expend little conscious or effortful thinking" (p. 22). Routine problems are addressed through a process called assimilation, that is, the ability to act gained through repeated practice, without conscious thought. Solving routine problems reinforces and refines existing knowledge.

> "For instance, if it is a quality problem, we have some procedures that we need to follow according to the Quality Manual, and the problems need to be registered as well as their own specific solution. The people involved in the problem and in the solution are also identified, so that if another problem like that occurs in another area of the plant, all employees have access to the problems and solutions database." (Group recall – Department Managers)

Non-routine, or novel problems, require "extensive conscious thinking" (Billett, 2001, p. 22) and extended knowledge through accommodation (Piaget, 1966). The learning occurs when one encounters a new task or challenge. Solving novel problems enables workers to identify and close gaps in knowledge and learn new models, clues and cues on how to proceed' (Billett, 2001, p. 28).

> "Solving new problems gathers the involved people in the discussion of the solution. They discuss the problem, identify it and implement several actions according to the problem resolution." (Group recall – Middle Managers)

BOSCH TERMOTECNOLOGIA SA routine in creating and using knowledge in problem solving process began with the problem-finding phase, then the problem is analysed by the Operator and/or the shift Manager. If they cannot solve the problem, they consult the quality database where they store all problems and solutions. If the problem is too complex, they created a team to solve it and when they find the solution, they implement it and register the problem and its solution in the database.

However, BOSCH TERMOTECNOLOGIA SA is always looking for new ways to improve their practices and routines. Middle Managers focus on a particular issue and determined to implement a more efficient methodology of problem solving.

> "There is going to be implemented a more rigorous, standard and detailed methodology, not only in the production lines, but also in the other sections of the organisation. BPS is going to organize what already is a good practice, making it even more efficient." (Group recall – Middle Managers)

> "Problem resolution is the priority; correcting problems is something that we think about constantly and whenever the machines are working. Our priority is keeping a continuous production process." (Group recall – Middle Managers)

> "We are already well equipped to facilitate problem solving situations and the plant organisation is an important factor, but the "Point Sit" [5]will help in this question, it will create standards, helping to solve problems more quickly." (Group recall – Middle Managers)

According to Johnson (1955), problem solving involves three phases: preparation (understanding the problem); production (developing different alternative solutions) and judgment (selecting a solution). Argyris & Schön (1996) suggest a fourth phase: review and reflective assessment of both outcomes and processes.

Even if it is important to have tools, procedures and routines to help the organisation respond to problem situations or challenges, this kind of factors can sometimes be a barrier to new knowledge development and even to knowledge use. One of the Middle Managers that participated in the group recall session was very concerned with standardization and routinization:

[5] Point Sit is a new methodology to be implemented and that will help to solve problems.

> "The question of standardization is 'sexy'. It is 'fashionable' but we do not always have a reason for it. In many cases, the profit does not compensate, and the goal of standardization is lost.
>
> Our biggest fear is to create documents or systems that become impossible to use either because the information is already clear and accessible or because information is difficult to access. (Group recall – Middle Managers)

"For example, a quality database is a powerful tool, but we don't have the competencies to use it. It is necessary to create an external tool that allows database access.

Creating a database was an imposition in order to improve the quality system, since it was necessary to register any problem. Now that we have a good database, we do not have enough knowledge to make queries and statistics. Not everything is pink, we have things to improve." Middle Manager

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However, even if BOSCH TERMOTECNOLOGIA SA had several routines to create and share knowledge, they would also need the space for informal sharing and its development. This is reflected in the Middle Managers words:

> "We don't have resolution procedures defined for all kinds of problems. What we have is formal and informal actions. Normally, organisational problems are decided in an informal way and we have a trend to extend these actions to technical problems. The impulse is not to appeal to the defined procedure, but to decide the problem ongoing. However, with the organisation maturity, the procedures are more adapted to the reality." (Group recall – Middle Managers)

e) Barriers associated to the introduction of new knowledge

Introducing new knowledge – technical or organisational knowledge – normally requires changes in products, processes or in the organisation itself. Some routines disappear and new ones are created as a form of new working practices implying an organisational learning process. In the beginning, workers seldom see this as a good thing and they often become resistant to change and build barriers. Production Managers have to deal with several situations of Operators' resistance and use some strategies to overcome the resistance:

> "When we started to implement BPS, main workers said: 'I've always done this that way, why do I have to do it in another way?'

However, today our goals are very clear and everybody knows what goals they have to reach at the end of the day. This wasn't so before BPS.

All the teams work a lot to reach the goals that were set, even if they are more and more difficult to reach. However, we can proudly say that some of the oldest workers want to participate and show interested in continuous learning. We cannot forget that we have some workers that have been working in BOSCH TERMOTECNOLOGIA SA all their lives, and work processes have changed very little in that time, but they show they are willing to participate in the change process.

There is still a group of workers that are resistant to change, but we try to involve them in the continuous improvement process. Even Managers need an extra stimulation to be motivated and to motivate their workers. This is an everyday issue." (Group recall – Production Managers)

Technicians have a similar perception of resistance to new knowledge introduced and in the implementation of changes:

"Things are moving very fast in BOSCH TERMOTECNOLOGIA SA and in the beginning we had much resistance. Even today, the team *methods and times* is seen as the "black sheep" by the other workers. Our main activity is to create and implement new processes and whenever we approach a workstation, our colleagues say 'here comes more work for us'.

Now their attitude is beginning to change because they realise that our work helps them be more productive and the work quality is improving. This has been an education process and now we can say that they see us like partners, making requests to make certain improvements.

We have an educational attitude, trying to make the Operators feel the need to change and not trying to impose anything. And today BOSCH TERMOTECNOLOGIA SA workers are accustomed to the change and adhere more easily." (Group recall – Technicians)

"One of our oldest colleagues is a focus of resistance whenever we try to implement a new practice. He used to say to me 'If this works ok know, why change it?', but when he sees better results, he tells me that I was right. But it's a very difficult process when one has to be constantly proving that change can be better." Technician from Methods and Times Section

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Operators confirm that the beginning of BPS implementation was a very difficult moment.

> "BOSCH TERMOTECNOLOGIA SA had a very good position in the market, and we didn't understand why it was necessary to make all those changes. Now we are not at *war*, but we still have some resistance, mainly from the oldest Operators. It is complicated because when we work for 10 or 15 years doing the same tasks, whenever a change is introduced all our comfort area disappears." (Group recall – Operators)

Middle Managers assume an important role when it comes to eliminating resistance by communicating and explaining the new philosophy to Operators. They are also responsible for maintaining and ensuring the success of the new dynamic of interactions with customers, suppliers, and outsourced functions and, at the same time, responsible for winning the Operators trust and complicity in all the change process.

> "The big changes started with the new General Manager in 2002. Until then we did not feel the need to modify our ways of working because BOSCH TERMOTECNOLOGIA SA was already a strong competitor.
>
> In the beginning, we had a lot of initial resistance, but those initial difficulties have already been overcome. An important aspect is the cleanness and the organisation of the plant, especially when it comes to manufacturing. The factory painting was also very important because it motivated the employees and contributed to a better image from the people who visited us.
>
> Initially, we thought that this was just a marketing operation, but now we understand that it was a very important action. It allowed us to increase people's motivation and we are now prepared for the day-by-day challenges." (Group recall – Middle Managers)

Middle Managers used an analogy to make workers understand the 5S principles, in order to make it easier to apprehend all those new principles in a very practical way.

> "To eliminate the resistance I have explained to my employees the 5S principles and made analogies with the organisation and cleanness of their homes, so it was possible for them to understand its importance. Today we are already accustomed to the constant change and the employees are much more involved, and this facilitates the acceptance of the system." (Group recall – Middle Managers)

Support areas faced BPS implementation and all changes more easily not only because their level of qualifications was higher, but also because they had already developed different kinds of tasks, not as routinized as manufacturing.

> "In the quality department, I didn't felt resistance in the projects' implementation because the employees came from different areas of the organisation, and participate intensively. We are always working these aspects, with systematic communication. The

idea is that everybody should know what is going on and what is going to happen in the near future.

When we work in the field, many changes are made in the proper sections. We create scale models in order to analyze layouts, new processes and procedures. People already find it normal to be always changing things. The change is part of the most recent history of the organisation." (Group recall – Middle Managers)

BOSCH TERMOTECNOLOGIA SA is an organisation in continuous change and BPS imposes a constant need for the creation of new knowledge, specially regarding to organisational innovation process. The innovation process assumes a greater role, not only because thermotechnology is always changing and new product innovativeness and new product performance are key outcome variables, but also because of the importance of implementing new ways of production, new organisational processes to accomplish an increased efficiency. Involving workers in this process requires the use of management tools like communication and promote workers' involvement and participation. These tools are reflected in all organisational actors' perceptions:

"Today most employees are open to change and participate effectively in the process. This is now our culture, but before the year 2002 we had another way of thinking. When we tried to introduce some kind of change, the first idea was 'this is not going to function'.

The employees have their comfort area that was created along the years they have been working in BOSCH TERMOTECNOLOGIA SA and we know that changes create insecurity. For example: they used to sit-down when they were working and know we have verified that it would be more efficient to work standing up because it's easier to pick up the tools and other materials and to make all the new routines. In the beginning, this was a problem because they said 'we have always done this like that and it worked very well, so why do we have to change?'

The reduction of stocks was also a cause of great anxiety. But now we work without stocks throughout the plant. Associated to that we have a cleaner plant, but employees needed to be educated to put the garbage in the containers." (Group recall – Department Managers)

One of most relevant example was studying with the Operators a way to change the tools of the machines in lesser time, changing from 10 minutes to 8 minutes. First there was a lot of resistance. The first idea was 'it can function here, but in my section it is different. I cannot do it. In my workplace this is impossible to accomplish', but know this is a reality." Middle Manager

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Another factor to take into consideration is the week hierarchical barriers between employees and Managers, since they both work very closely in the plant and as a team solving all problem situations (as a result of new changes implemented or because of some machine malfunction or another type of problem). There are not many barriers to the communication between Operators and Managers.

> "Transparency is a very important factor in the work environment. It eliminates communication barriers since any person can communicate directly with any hierarchic level and this is a very important facilitator." (Group recall – Middle Managers)

> "We now know who are the employees that are more open to changes and we use that information to implement change in their workplace first. They participate in the change helping to adjust the new practices and work processes and when it works efficiently, we extend the change to other sections in the plant. This is a very important process, because we show all the plant that the new change brings advantages for the organisation and for the employees too. Later on it becomes easy to spread the change made to another sections of the organisation since it already demonstrated to have a positive result." (Group recall – Department Managers)

Now almost all BOSCH TERMOTECNOLOGIA SA workers can see the importance of these changes that begun when the new CEO returned to the organisation in 2002 and began the implementation of BPS:

> "Changes had always existed, but it has speed up for the last 5 years since Engineer Paulo Oliveira became General Manager. We understand the need for these change, because the world is in constant change and if we not make changes our competitors will become more powerful and we will lose the competition." (Group recall – Production Managers)

> f) Managers' roles in promoting employees' participation using new knowledge and sharing their own knowledge.

To compete in new markets, BOSCH TERMOTECNOLOGIA SA realized that the company had to be both highly skilled at operations and capable of thinking and acting strategically. To implement BPS, both top and Middle Managers have been a key factor, using all the tools to inspire employees into a higher participation, and promoting the use of their knowledge in all aspects of the organisation.

> "The General Manager of BOSCH TERMOTECNOLOGIA SA is seen every day in the plant talking to employees, participating in the discussions held to solve problems and

participating in the decision-making about several issues. For example, when the night shift dad problems, he held a joint meeting with them in order to solve them.

The introduction of BPS reflected on the top management behaviour and his line of action. It integrated the philosophies that already existed in BOSCH TERMOTECNOLOGIA SA and the role of the General Manager was very important in the assimilation of the new processes and in overcoming all barriers. But this kind of involvement of top management, doesn't stop there. All Managers and area or shift Managers are always in contact with the Operators, acting as coaches. And we can say that each section is a reflection of its Manager." (Group recall – Department Managers)

In many cases, companies have tried to transform themselves without rethinking the way in which they implement new processes, and the result can sometimes generate conflicts among workers and a loss of productivity. BOSCH TERMOTECNOLOGIA SA developed their Manager's competencies as coaches transforming them into facilitators for implementing the new production system and the new organisational processes. Middle Managers are in the right place to judge the complexity of a situation, to understand the knowledge applied during each specific situation, to adjust goals in real time, and to integrate individual knowledge into norms and organisational procedures. BOSCH TERMOTECNOLOGIA SA invested in their Middle Managers' competencies in order to become able to transform individual knowledge into collective (organisational) knowledge.

"We have a genuine plan and intensive actions from management to promote changes and these are, at the same time, the basic and a critical aspect for the success of the continuous improvement and the change.

"The workers' involvement in the change is very important. I cannot just tell them what is going to happen, I need to involve them, to make them part of what is going to happen. The BPS tools brought this part of management to BOSCH TERMOTECNOLOGIA SA.

To change habits and behaviours, the organisation gives workers information and tips about it. Change doesn't require a great effort, only a bit of consistency and stamina in order to change cherished habits." (Group recall – Middle Managers)

The BPS Manager has had also an important role in the implementation of the principles and in promoting employees' participation to use and share their knowledge:

"The implementation of the BPS is a top-down process: BPS Manager worked sufficiently in this area through training and promoting communication and dialogue in all sections of the plant.

> Human resources had developed an interesting activity that helped workers to learn BPS principles. Each month they sent a postcard with one of the principles along with the salary receipt. Since then workers began to know the principles and started to identify themselves with them." (Group recall – Middle Managers)

Middle Managers participated in the resolution of certain problems and developed strategies that could be learned by other employees and be applied in other areas of the organisation, capturing knowledge shared in real time. This is what we can call *Dynamic Knowledge*.

5.2.5.4 3rd Dilemma

"Using and sharing individual knowledge is crucial to organisational innovation processes, but organisational culture and management resistance makes it very difficult to promote employee's involvement and participation."

Several studies have indicated that organisational innovation depends not only on employees' abilities, but also on management strategies, policies, and actions (Frambach & Schillewaert, 2002; Scarbrough, 2003). Ong et al. (2003) argued that organisational support is positively related to an innovation-supportive culture. Organisational support refers to the degree of organisational encouragement and resource capability regarding employees' work environment (Eisenberger et al., 1990). In the context of knowledge sharing, the different aspects of organisational support are critical driver of knowledge sharing. Such is the case of top management support (Lin & Lee, 2004; Bock et al., 2005), employees' involvement (Bock & Kim, 2002; Connelly & Kelloway, 2003), reward systems linked to knowledge sharing (Bartol & Srivastava, 2002), and knowledge networks such as the intranet, communities of practice, and so on (van den Hooff & de Ridder, 2004). With the development of a knowledge-sharing culture based on more congruent Manager perception and organisational readiness, the organisations might perceive knowledge sharing as beneficial and compatible with their organisational policies. Hence, the casual link exists between organisational support and innovation characteristics of knowledge sharing.

a) Knowledge culture

Knowledge had become the most important toolkit for competition and survival under the business climate in the beginning of the 21st century (Ling, 2003).

An innovation culture can cause a significant positive influence on knowledge acquisition and diffusion. This kind of culture must start with clear communication from

the top about the importance of information sharing, and this has to be strengthened by the engagement of Middle Managers in regular knowledge sharing sessions.

Dewett & Jones (2001) also consider that organisational characteristics play a strategic and crucial role in influencing organisational change, innovation, and the outcomes, especially in knowledge-sharing areas (Pan & Scarbrough, 1998; Koh & Kim, 2004; Evangelou & Karacapilidis, 2005).

BOSCH TERMOTECNOLOGIA SA has been creating this kind of culture since BPS implementation and they have a propitious climate to share not only technical knowledge, but also organisational knowledge. Even if their nuclear competitive advantage arises from heating water technology, organisational knowledge is seen and developed with a major importance within BPS boundaries.

> "BOSCH TERMOTECNOLOGIA SA is a learning space, in a technical and organisational level and one of the most effective tools to create and disseminate knowledge is through workshops with people from different sections or people from just one section. For example, line 6 had a great change. We organised several workshops involving all the workers from this line." (Group recall – Department Managers)

"Every day I learn a new thing in this organisation. With my colleagues, with Operators or even Managers, but we are always very active, and something new always needs our attention." Technician from Methods and Times Section

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A fact with major interest is that BOSCH TERMOTECNOLOGIA SA knowledge sharing routines involve not only internal actors, but also external ones like, for instance, customers. They bring fresh and new ideas especially to improve products, as the Department Managers point out:

> "When we need to improve our products, we organize workshops to discuss the new possibilities and functionalities that they could/should have. We invite several people outside the organisation, mainly costumers. Sometimes they have very simple ideas that we would never have remembered because we were focus on a more complex problem. Their ideas give us a new and fresher perspective of the possibilities that our products could have and this is phenomenal because our costumers normally identify themselves with the new improvements that emerge from this sharing." (Group recall – Department Managers)

Even a specialist in a certain area can help the discussion and create some knowledge that can help to implement a new practice, tool or technology:

> "The workshops sometimes have an external moderator, someone with specific knowledge. This helps us to develop ourselves in an organisational and technological way. Sometimes it is a specialist belonging to the BOSCH group (from another factory with a different line of products), other times it is a consultant or someone from the Academy." (Group recall – Department Managers)

When they have a production problem, the workshops involve only internal actors from different sections of the plant so that together they can all find a solution or a way to minimise the consequences of a problem.

> "When we have some kind of problem, the moderator is internal and the idea is to involve all workers related to the situation under discussion. This workshop has very well defined goals and if the workshop finishes without having solved a certain problem, a schedule is defined with actions delimited in time until the problem or the situation is solved.
>
> The greatest advantage of workshops is that people who participate in them are an integrant part of the problem or situation. An example of a problem that we discussed in a workshop was regarding auto-quality – we intend to reduce the incidents of line 1." (Group recall – Department Managers)

The workshops in BOSCH TERMOTECNOLOGIA SA can be seen as knowledge creation processes, such as communities of practice or other processes of linking workers to others with expertise. Relational competences are a key to the capture, use and creation of knowledge and learning within organisations.

However, it is important to think about the key challenges involved in building strong relationships between employees. The management challenge is to create an environment that values sharing knowledge and the personal challenge is to be open to the ideas of others, and also be willing to share ideas.

In BOSCH TERMOTECNOLOGIA SA, even an operation of acquiring a new machine or technology can involve everyone in the process. This can be another opportunity to learn by sharing knowledge:

> "When we need to buy new technology, the Engineering Department supplies services to the manufacture (their customer), but we don't buy an equipment without their opinion.
>
> The knowledge that production workers have about the equipments' operational function is very important when it comes to choosing new equipment, and they provide

> important help during the implementation process, especially during test and customization phases.
>
> The Engineering Department does not impose the equipment. The specifications are defined together with Manufacturing. This has a big advantage: workers become co-responsible for the equipment. We make production a part of the solution and not part of the problem.
>
> If we do not ask for the participation of all and just present a solution, it is a recipe for trouble. All kinds of barriers appear, like poor use of the equipment, and several problems will emerge… we have no doubt of it.
>
> We also consult other areas to see if there is not any security, environment or quality problem. It is important to involve everyone who will be affected by the equipment. By giving one's opinion, people participate and become more aware of the machine and its potentialities." (Group recall – Department Managers)

This kind of behaviour helps to develop a more consistent knowledge-sharing culture. Employees share ideas and insights naturally and not as something they are forced to do. Jones et al. (2006) argue that the ability of organisations to successfully promote a knowledge sharing culture depends not only on directly including knowledge in the business strategy, but also on changing employees' attitudes and behaviour to make them willingly and consistently share their knowledge.

It is also important that employees and Managers see the connection between sharing knowledge and achieving the business goals or solving practical problems.

Several researchers argue that another way to create a culture of knowledge sharing is to promote skills development. These leave us to BOSCH TERMOTECNOLOGIA SA training routines that have the aim to help employees to develop their knowledge and competencies.

BOSCH TERMOTECNOLOGIA SA has several routines to identify lack of skills or competencies that need to be developed. One of most important is the share among the workers and their Managers during performance evaluation meetings.

> "The MAG, our performance evaluation system, is an instrument that helps identify the existing competencies and the lack of competencies. This is defined between the Manager who does the evaluation and the employee. This information is inserted in the training matrix, but throughout the year new needs of training are identified." (Group recall – Middle Managers)

> "We have a lot of training in electronics and electricity, but also in interpersonal competencies to help some workers improve their relations with the suppliers. They need to know how to treat their external and internal clients, because the relationships were difficult and sometimes they even treated the clients by shouting at them, which created a very bad climate". (Group recall – Department Managers)

"When something went wrong, some of our workers didn't know how to explain the situation or to solve the situation and they would become stressed and they would shout at everybody. Now we have been able to diminish these situations with training." Technician from Methods and Times Section

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Another way is collecting information from the area coordinator, together with the mechanisms created by the Training Manager.

> "The area coordinator identifies the need for competencies development and the training needs." (Group recall – Middle Managers)

> "The sections' Managers also propose training in specific areas and even the worker can, at any time, suggest specific training, even if it's not related to his work." (Group recall – Department Managers)

Creating potential is one of the training goals in BOSCH TERMOTECNOLOGIA SA. They invest in their workers so that they can assume more responsibilities and become more knowledgeable.

> "All the knowledge acquired during training sessions is to be applied in the organisation. Even if the knowledge is not needed at that specific moment, it has the potential to be used later on. For example, one of our employees had training in the German language so that, when necessary, he could make the necessary translation instead of appealing to an external translator.
>
> Sometimes the training is used to develop some competencies in order to prepare the collaborator for bigger responsibilities. However, we had some cases where we lost a good Operator and gained a bad Manager." (Group recall – Department Managers)

Technicians also refer the importance of training and even the production constraints that can always be overcome. BOSCH TERMOTECNOLOGIA SA has continuous production and the assembly lines can never stop because of the enormous costs. It is, therefore, necessary that training sessions be organised to be attended by all without influencing production.

> "Normally, we have a lot of training. The shifts are continuous but all Operators participate in training sessions.
>
> Workers can identify training needs and even if they don't need a specific skill for the task they are performing, the knowledge gained can be used in a future situation. For instance, I asked for a course on Excel even if it was not directly relevant for my work. Normally, we can identify any training need; sooner or later it can be helpful for the organisation." (Group recall – Technicians)

Operator's considerer that BOSCH TERMOTECNOLOGIA SA uses training to make workers more efficient, and to help them carry out their tasks.

> "For example, I work in the gas composition, and I had training in welding and points of fuse are crucial for developing my tasks. We have explored them theoretically during the training sessions and that helped me to improve practical tasks.
>
> My case is another example, I work as a "machine controller", and training helped me to understand the machine I work with. This is very important to make it more efficient." (Group recall – Operators)
>
> "Technology and work methods change. Therefore, if we don't have training to help us develop ourselves, the organisation loses the initial investment that was about 1000 hours of training." (Group recall – Operators)

Training also assumed an important role when BPS began to be implemented. All was new: principles, practices, and processes. It was a moment when creation and sharing performed a nuclear role.

> "When we introduced BPS all employees needed training in all its principles. This training still continues, whenever a new tool is implemented. First we have theoretical training and later on the training has a practical application in the field." (Group recall – Department Managers)

For Operators, BPS training was very important to reduce resistance and to disseminate knowledge about the system. One of the Operators referenced the importance that BOSCH TERMOTECNOLOGIA SA gave to this kind of training by introducing BPS in the organisation:

> "I had BPS training to apprehend its principles, its goals, its tools and instruments." (Group recall – Operators)

Regarding formal education, BOSCH TERMOTECNOLOGIA SA assumed a responsible position creating conditions for the workers with few qualifications to finish their secondary education.

> "Some of our workers had only the 5th grade, but they have studied to finish the secondary education. BOSCH TERMOTECNOLOGIA SA tries to involve more workers in the formal learning process, because workers' development is good for them and also for the organisation." (Group recall – Production Managers)

Middle Managers are also aware of the importance of sharing knowledge during work process:

> "Technical competencies develop themselves mainly through the system of learning by doing, and not only through training. We have a vast experience that gives us a great potential to learn and the management style supports and takes a chance on employees' empowerment, creating a greater potential of development." (Group recall – Middle Managers)

Another way of developing the knowledge spectrum of employees is the possibility of mobility among the Bosch Group.

> "BOSCH TERMOTECNOLOGIA SA is a very dynamic organisation. Employees have always several chances to develop themselves, not only in BOSCH TERMOTECNOLOGIA SA but also within the Bosch group where we have several opportunities to work in other areas." (Group recall – Middle Managers)

In July 2006, BOSCH TERMOTECNOLOGIA SA had 20 employees in a mobility scheme. Human Resources Department has mobility instruments and any employee can ask for a new challenge.

BOSCH TERMOTECNOLOGIA SA is creating a knowledge culture and has an enormous potential to become a knowledgeable organisation using several routines of knowledge management. It is a perfect workplace where employees are part of the process and their importance and the importance of their knowledge for the future of BOSCH TERMOTECNOLOGIA SA are widely recognised.

b) Space for workers to analyse their work

Worker participation can promote improvements in areas like product design, manufacture and delivery. If workers have enough space and time to analyse their own work, this may lead to an effective reduction in the time and cost incurred in switching

between alternative product lines, improving a product design, or incorporating design improvements into the production.

> "Some of our workers analyse their work. They are the ones that are always trying to make improvements. Others only follow routines and procedures." (Group recall – Production Managers)

According to Production Managers, BOSCH TERMOTECNOLOGIA SA has created several mechanisms to allow workers to analyse their work:

> "Sometimes we need to create a team to analyse and solve a problem, but the worker is always part of the team. We think this is a way for all of us to learn more about our work." (Group recall – Production Managers)

However, Operators point out a very important participation constraint – time:

> "Our work implies preventing the production lines from ever stopping functioning. Because of this constraint, we have very little time to think." (Group recall – Operators)

Some tasks are very important for the regular work, like the 1st level of maintenance, and these tasks are defined and we have to follow them, leaving no space for analysis.

> "We have time to make maintenance to the machines and if I don't follow the rules and the machine stops, this affects the whole production. It's important to follow the rules". (Group recall – Operators)

But not all Operators share the same thoughts about this issue: some of them refer the importance of innovation and improvement:

> "I agree with my colleague, but if we do not stop today to innovate, to improve, in the future we will continue to make things badly. BOSCH TERMOTECNOLOGIA SA gives me the possibility to observe, to analyze and to consider new things". (Group recall – Operators)

All agree that in the beginning of BPS implementation workers were asked to participate actively in the change process with their ideas, opinions and suggestions. It seems that a great number of workers have answered that appeal and gave suggestions about the way they were doing their jobs, at all levels of the organisation.

> "The BPS pushes us to think and make changes in all organisational areas - logistics, layouts, work processes. We aim to improve the company's efficiency." (Group recall – Operators)

Middle Managers agree that BPS introduced a new way of thinking, and created a chance for all to participate in the organisation's new life:

> "The introduction of 5S was the beginning of the reorganisation in BOSCH TERMOTECNOLOGIA SA. The message to employees was 'imagine you are in your house'. The stockings placed in the stockings' drawer, the shirts placed in the shirts' drawers and so on. Today employees see their work space as if it was their house and they are always trying to improve it." (Group recall – Middle Managers)

5s programme also helped to create a culture of improvement among workers that participated not only during the analysis process but also in the implementation of the new work practices or processes.

> "In the beginning of 2006 the laboratories had a score of 100% in all 5S standards during evaluation, and we commented that we had reached a state of perfection. 3 months later a new detailed audit to the 5s showed results below 90%. Now we have new standards to reach and we need to improve our performance.
>
> To accomplish this new goal we have to think of new ways of doing things in order to reach the new standards. We had to analyse and redefine our processes of work.
>
> In production, standards have existed for a longer period of time because several employees shared the same workstation and because they had very high productivity goals. This made it easier to create an organisation system for all the Operators.
>
> However, production employees are always stimulated to analyse their processes and make suggestions to improve it." (Group recall – Middle Managers)

c) Managers' role

Management style and organisational culture, along with commitment and trust, are described in the literature as factors that affect the willingness and openness of the workers in individual knowledge sharing.

Trust helps to eliminate resistance barriers to knowledge sharing and promotes the cooperation that is required for successful knowledge sharing. Hence, when promoting knowledge sharing, Managers face the important problem of instilling trust into the organisation.

Embedding a culture of knowledge sharing and reuse is perhaps the most important challenge for BOSCH TERMOTECNOLOGIA SA Managers. It's less about managing

knowledge and more about managing workers whose work depends on what they know and what they can learn from each other.

Technicians showed a huge respect for BPS Manager insisting that he worked very close to them in BPS implementation.

> "The implementation of BPS is a top to bottom process and Emanuel worked sufficiently in this area. One of the main processes of knowledge sharing was through training." (Group recall – Technicians)

On the other hand, BOSCH TERMOTECNOLOGIA SA CEO is the key element for the success of the organisation not only at a strategic level, but also because he helped the Managers and the workers to solve the problems participating effectively in the all the organisation life.

> "Engineer Paulo Oliveira, BOSCH TERMOTECNOLOGIA SA CEO, is seen every day in the plant talking to workers and participating in the discussions held to solve problems.
>
> The decisions about several issues are participated. For example, when the night shift dad problems, he held a joint meeting with them in order to solve them." (Group recall – Technicians)

All the other Managers also assume an active role in the process, using tools to stimulate workers to participate and promote the use of their knowledge.

> The introduction of BPS reflected on the top management behaviour and his line of action. It integrated the philosophies that already existed in BOSCH TERMOTECNOLOGIA SA and the role of the General Manager was very important in the assimilation of the new processes and in overcoming all barriers. But this kind of involvement of top management, doesn't stop there. All Managers and area or shift Managers are always in contact with the Operators, acting as coaches. And we can say that each section is a reflection of its Manager." (Group recall – Department Managers)

Manager's feedback about work performance is another important way of developing the CIP and the knowledge sharing process.

> "Recognition and feedback about our work should occur more often. This would increase Operator's satisfaction and give us more information about our own needs of competencies' development." (Group recall – Technicians)

The CEO involvement in the plant operations and his recognition about good performances is a huge motivation factor for Operators and helps create an innovation and participation culture.

> "The feedback from BOSCH TERMOTECNOLOGIA SA CEO is very important for us because it increases our motivation and commitment. Sometimes he sends us emails about our performance and results. We do not have access to the email, but each Shift Manager transmits the message. This makes us feel part of the whole process" (Group recall – Operators)

Explicit reward systems (e.g., promotions and rewards) are used to enable knowledge contributions as well as reuse.

> "Good performance is evidenced by an annual reward. This reward is given to the team who achieves the best results." (Group recall – Operators)

> "Bad performance is remembered forever. Good performance is what we aim at and it shouldn't be something that needs to be evidenced." (Group recall – Operators)

"We are here to work and to work with quality. This should be our main goal and the company already pays us for this." (Operator from Production)

As to feedback, Department Managers have a different perception: they think feedback exists on a daily basis and they use it as a management tool to enhance workers' performance.

> "Feedback exists on a daily basis. We don't wait for the annual Performance Appraisal. If the worker performance is not as good as should be, we try to define another strategy or corrective actions.
>
> If the worker shows a high performance, we have mechanisms of recognition, like through direct communication, when we say 'You did well'. This is a fundamental mechanism of motivation." (Group recall – Department Managers)

In this context, it's possible to affirm that Managers have a fundamental role in motivating the promotion of individual knowledge sharing and BOSCH TERMOTECNOLOGIA SA Managers reflected this through all organisational actors' perceptions. They encourage employees to continually refresh and share their knowledge through training. They train their workers so that they can deal with routine work. Besides these specific skills that are taught, there is also room for complementary skills related to the way they do business in the present dynamic and

competitive environment. For instant, courtesy towards customers, accuracy and timeliness of responses to customer's inquiries, and responsiveness to customer's demands, are all considered critical.

Managers also promote collaboration because some tasks are very complex and require a deeper analysis of the problems. Workers commitment is critical for the implementation of new practices or processes because if their views and perspectives are not taken into account in seeking the solutions for organisational problems, the organisation is likely to suffer from implementation problems.

d) Responsibility for the organisation's performance

Knowledge sharing may lead to benefits in the form of measurable improvements in work efficiency, productivity, and on-the-job effectiveness, eventually resulting in higher profits.

BOSCH TERMOTECNOLOGIA SA implemented Visual Management in the plant so as to make all the workers feel more responsible for the results they achieve. Each team controls the other team's performances and tries to achieve better results. This kind of management involves the workers in a way that improves their commitment to the organisation's performance.

> "In the communication corners we have placards with information about the team's performance, and each performance contributes to the team values. They feel responsible for the team goals, and in each month we have a winning team. This motivates them and makes them feel responsible for their work." (Group recall – Department Managers)

When a team's performance is not good, the Manager and the team members analyse the situation and try to identify the causes and possible solutions.

> "In BOSCH TERMOTECNOLOGIA SA, efficiency is measured every hour and when the results are not good, all of those section workers are informed of this fact and the results they have reached. The Manager schedules a meeting in the communication corner and informs them: 'Attention! Yesterday it did not run well. This section didn't have very good results at the end of the day'.
>
> Then, together they analyse what happened and what they have to do in order to reach the defined results for that section. These results are posted in tables and charts in the section's placards and everybody can look at them.

> This way all teams can compare the results, and they know that if some results are not good they will influence the annual average, and the team's reward. Because the work is done in teams, the performance of one worker will influence the whole team's performance." (Group recall – Production Managers)

Beside the team's performance, every worker is responsible for his own productivity and quality of work, being rewarded as an element of a team and assuming functions that require more responsibility.

> "If the performance is good, we look for some potential and give the worker more responsibilities. However, this is not always a good policy and it can have bad consequences. In the past, we have promoted Operators with excellent performance to shift Managers, but it was a mistake because they were not prepared to assume that kind of responsibility and they didn't have the required profile." (Group recall – Department Managers)

Operators refer that the presence of temporary workers in the team influences the performance because they are not as motivated as the other workers.

> "We have a reward for our performance, but some time it is difficult to achieve good results because some of our colleagues are temporary workers and if they are near the end of the contract they are not motivated and don't help us reach the defined goals for the team." (Group recall – Technicians)

But they have a strong idea about the behaviour that they have to develop:

> "We are paid to make a good work". (Group recall – Operators)

Production Managers point out the importance of the feedback about the team's performance in order to create compromises with the workers and to make them aware about what is going on in the factory.

> "In the assembly lines the workers must be very well synchronized. So, it's important to give constantly feedback about individual and team performance. It is also very important that all Managers and supervisors inform their workers about what is happening in the other sections of the factory, because almost every problem has consequences in every section and in the final product.
>
> If the product leaves the factory with some flaw, it can cause serious damage for the company's image and consumers' trust, as well as additional costs for the company." (Group recall – Production Managers)

Sharing knowledge between workers and Managers, and between workers and their colleagues assumes a very important role in strategic management. It is even more important in practical management since it allows each worker to know his own workplace even better and to know the whole process and not just the small part of the process that he is a part of.

5.2.5.5 4th Dilemma

"Organisations need to promote individual knowledge sharing among all organisational actors, but organisations don't see the need for creating mechanisms to promote this sharing."

In order to enhance interactions between employees, an organisation can use a wide variety of mechanisms, including brainstorming, dialectical thinking, and continuous experimentations (Bhatt, 1998).

BOSCH TERMOTECNOLOGIA SA uses several mechanisms in order to develop new products or processes, trying to be more sensitive to the new realities of the market:

- suggestion boxes for developing new ideas
- regular meetings and workshops to share work-related knowledge;
- encouragement to share effective solutions in work-related issues, and
- Support for open communication.

a) Suggestion boxes

Darroch & McNaughton (2002) identified that knowledge sharing can be viewed as an organisational innovation that has the potential to generate new ideas and develop new business opportunities through socialization and learning process.

For BOSCH TERMOTECNOLOGIA SA, the new ideas creating process is very important and one of the techniques that they use is the Suggestion System. To implement this system they had to create a culture of workers' participation that began with a three-phase process:

- *Encouragement* of workers by making an effort to help them provide suggestions that could improve their job. This helped workers to look at the way they were doing their jobs.

— *Coaching* employees so that they can provide better suggestions. They *educated* them in order to provide better suggestions, focusing on analyzing problems and the environment.

— Defining a system to reward the best ideas according to their economic impact.

Department Managers focused the importance of the suggestion system for the new ideas creation process.

> "We motivate the development of new ideas in all our workers. They can give suggestions about anything related to BOSCH TERMOTECNOLOGIA SA and not only related to their specific workstation. At this moment (July 2006), we have (more or less) 500 suggestions of improvement. We want to reach 3 suggestions per person, but at this moment we have only reached 0, 5%." (Group recall – Department Managers)

To facilitate the suggestions process BOSCH TERMOTECNOLOGIA SA placed suggestions boxes all over the factory.

> "We have suggestion boxes all over the factory, and each worker can make suggestions." (Group recall – Department Managers)

All the suggestions that are accepted are rewarded. The rewarding system is one of the critical factor of success of the system, since it motivates the participation and gives workers a sense of being important to the factory - they became part of the solution to make the company more competitive.

> "The owner of a suggestion that brings monetary benefits for the company receives 20%, as long as it does not exceed 5000 Euros." (Group recall – Department Managers)

Besides the monetary compensation, some suggestions receive points that can be exchanged for domestic appliances. They can choose from a placard that has information about Bosch's domestic appliances according to the number of points that they have won.

> "If the suggestion is accepted, we create an economic ratio that integrates a percentage for the worker, depending on the money saved. If it is an improvement suggestion, the worker wins points that can be exchanged for BOSCH's electrical appliances. In the plant a placard is displayed with the number of points needed to obtain each electrical appliance." (Group recall – Production Mangers)

The main subjects in workers' suggestions are improvements in their own work, the working environment, machines and processes, tools, office work, product quality and ways to save energy, materials and other resources, ideas for new products, customer services and customers' relations.

> "Most suggestions is related to the workers' section and specific work. For example, to obtain more efficiency they suggested a new position to place the tools. This suggestion helped win more time. However, sometimes workers give suggestions about other sections or even the plant organisation." (Group recall – Production Mangers)

However, BPS makes them focus in increasing the efficiency of the plant:

> "Some of the suggestions were intended to diminish the time required and to increase efficiency." (Group recall – Technicians)

BOSCH TERMOTECNOLOGIA SA Operators are aware that BOSCH TERMOTECNOLOGIA SA spends too much time analysing all the suggestions. Some of these are important to implement as soon as possible not only because they may save time and money, but also because they can influence Operators' regular work, which makes it unwise to wait for all the phases that the suggestions' analysis undergo. In these cases, they make the suggestion directly to their Managers.

"For instance, I suggested help to solve a situation that was causing problems in the production. One of the machines had a problem and during a whole year electricians, mechanics and the Technicians tried to find a solution, but they could not reach an adequate solution. Because I was an Operator and knew the equipment very well, my proposal was to arrange the electric program and with this new programming, we arrived to a feasible solution. My solution was accepted, but it did not pass through the suggestion box." (Group recall – Operators)

One of the main problems of the suggestion boxes is that BOSCH TERMOTECNOLOGIA SA showed some difficulty in analysing all the suggestion within a short period of time, causing some frustration in the workers. However, Production Managers are aware of the situation:

> "At this moment the system is not as efficient as we would like, because the reply time is too long and the worker becomes very anxious. But all suggestions are analysed and decisions are made." (Group recall – Production Managers)

Department Managers also referred that all the suggestions were analysed and decided upon, pointing out that BOSCH TERMOTECNOLOGIA SA has a team that analyses the suggestions. However, it seems that this is not a permanent team, having sporadic meetings to analyse and decide about the feasibility of the suggestion given.

Operators' perception about the time spent analysing suggestions and making a decision implies costs to BOSCH TERMOTECNOLOGIA SA, which brings difficulties to the process:

> "We understand that it is very complicated to analyse all the suggestions given by the workers. The number of suggestions is very big and it requires time and one full-time person dedicated to the analysis and this implies costs to the company". (Group recall – Operators)

BOSCH TERMOTECNOLOGIA SA is aware of these constraints and is trying to solve the problem. On the other hand, to diminish workers' anxiety they have created a system that monitors the state of the suggestions made by the workers.

> "Sometimes we wait for a long time for any feedback about our suggestions. However, on the intranet we can verify the state of our suggestions. If our suggestion is not accepted, it is kept in the system because today it may not make much sense to implement, but in can turn out to be an important suggestion in the future." (Group recall – Operators)

Despite the constraints of the analysis, all suggestions are analysed and a response is given to the promoter of the suggestion. But other constraints emerge for the suggestions' implementation:

> "We leave the suggestions in the box; they are analysed and even accepted, but sometimes they cannot be implemented because of the implicit costs. For example, someone gave the suggestion to place a computer in the plant's leisure zone so that workers could consult the state of their suggestions. This was accepted, but it was not implemented.
>
> We continuously use the same method of communication. Managers give information about the state of the suggestions to the Operators during the meetings in the communication corners." (Group recall – Operators)

To promote the suggestion system and to stimulate workers, BOSCH TERMOTECNOLOGIA SA uses visual management techniques. They have several placards all over the factory with charts, photographs and short notices about the

suggestions implemented. They also have a placard for the suggestions' rewards, where workers can choose what kind of reward they prefer according to the accumulated points that they have reached.

> "We use visual management techniques that motivate continuous improvement. It includes displaying photographs in the plant, showing the situation before and the situation after the improvement." (Group recall – Production Mangers)

b) Workshops

Other mechanism to promote the development of new ideas is through workshops on innovation and new products.

> "The innovation workshops involve external people from different areas and people who don't know our business. These can be creativity workshops; some of the participants are customers who make elementary questions, but that make us see things in a different perspective." (Group recall – Department Managers)

In these workshops, they use techniques by which collective tacit knowledge is created and shared like brainstorming, gathering a set of experts with diverse skills, and preferably including customers.

BOSCH TERMOTECNOLOGIA SA is a part of a Group of organisations who also share other perspectives through interchanges.

> "Out of this friction of competing ideas can come the sort of improvisational sparks necessary for igniting organisational innovation." (Group recall – Middle Managers)

c) Knowledge networks

On another level, the R&D Department shares knowledge through knowledge networks. Organisational knowledge is far more important than the individual expertise possessed by marketing, manufacturing, or R&D in developing a new product. BOSCH TERMOTECNOLOGIA SA has access to Bosch's knowledge networks. It is important to point out that R&D team is composed by workers that come from different countries and organisations within the BOSCH Group, and they are open to different levels of knowledge creation and sharing.

> "Our investment in R&D is enormous because innovation is one of our most relevant competitive factor. This is a huge investment in thermotechnology innovation." (Group recall – Department Managers)

Knowledge networks are, according to Coleman (1988), the primary source of social capital, that is, the productive potential that is derived from the structure of relations between individual actors and they play a particularly important role in innovation and entrepreneurship (Ibarra, 1993; Chung & Gibbons, 1997; Young, Charns, & Shortell, 2001; Yli-Renko, Autio, & Sapienza, 2001).

In fact, some studies have shown that a large proportion of innovative ideas may originate from outside the firm (Carter & Williams, 1957; Myers & Marquis, 1969; Allen, Hyman, & Pinckney, 1983). Middle Managers reinforce this idea:

> "Our primary source of innovation is BPS and we learn from the experience of other organisations from the Bosch Group, from our interactions, workgroup participation and mutual visits". (Group recall – Middle Managers)

Department Managers referred the engineering technological network to support the new acquisition of technology.

> "We have a technological network in engineering. This is a network that involves the equipment suppliers. When we need information about some kind of technology, we use the network." (Group recall – Department Managers)

Operators do not have any perception about the existence of knowledge networks in BOSCH TERMOTECNOLOGIA SA. However, they referred the BPS Passport that contains information about all the programs they participate in:

> "The Operators have a BPS passport that has their competencies and knowledge. It is a register of all the programmes they have participated (TPM, OKIOKIS, among others)." (Group recall – Operators)

This reflects the interactions they have with other workers using several kinds of mechanisms to create and share knowledge. After all, they participate in several knowledge networks even if they do not realise it. Production Managers group recall reflects this statement:

> "We promote the participation of workers from different sections in different projects. For example, in TPM projects there are normally workers from Production Department and Maintenance Department attending. There is always someone from another section participating in the section project." (Group recall – Production Managers)

Some of these networks are informal and emerge spontaneously. People share ideas and work together and, in the meantime, share knowledge even when no one requires

them to do so. The knowledge flows much better under informal networks assuming a *dynamic* nature than through the hierarchical structure.

5.2.5.6 5th Dilemma

"Knowledge is recognised by researchers and practitioners as a fundamental asset to organisations' survival; however, organisations don't integrate and effectively use new knowledge created or developed by employees."

New knowledge is an important element for workers to examine and adapt to new practices or processes in their own workplaces. However, there is a limited perception of the usefulness of new knowledge. Sharing new knowledge that was acquired trough a review, a conference, a training session or in another process is not yet an easy process in many organisations.

The big question is: how to promote the internalization of the new knowledge used in the organisation?

a) Integration of new knowledge and its effective use in everyday work

The integration capacity can be measured using the degree of workers' ability to perform different tasks, together with the rotation degree between workers and the organisation of specific training.

Most organisations have difficulties in integrating knowledge that workers acquire from training processes. However, Department Managers explained that the training plan is made with several criterions and one of them is that workers must receive training related to their job, making the application of the knew knowledge easier and immediate.

> "The new knowledge is integrated in the job description. If the knowledge is acquired during training, we want it to be applied in the field. Also, the introduction of a new technology involves the development of new knowledge that is crucial for the production.
>
> For instance, maintenance is a good example because new machines or equipment need new knowledge so that workers can be trained to answer to problems when they occur. Therefore, they have special training needs in several technical issues, witch are always applied in the field." (Group recall – Department Managers)

On the other hand, it's important to integrate all the knowledge related to Engineering, Maintenance and Production because it's always needed to solve emergent problems.

> "Every machine with some kind of problem needs urgent reparation and the employees have to use their technical knowledge and experience to deal with the situation." (Group recall – Department Managers)

b) Incorporation of new knowledge into new products, services and processes

Environments created inside organisations generate the conditions that can either encourage or diminish knowledge application and integration when creating new and improved product and services.

> "We are always improving our products and processes and most Operators follow the changes and accept them. However, in the beginning they assumed a suspicious attitude about it. Later on we normally proved that the change was better. For example: the two boxes' system. Each workstation had only one box until we introduced another box. Operators showed some resistance, but today no one can work differently.
>
> Today there is almost no resistance to change because we are always changing, and workers participate actively in all the changes. They understand that the changes improved their work." (Group recall – Production Managers)

Sometimes the innovations are developed due to clients' demand:

> "We have standard products but sometimes we make changes ordered by our clients. It's not always possible to answer to clients' demands because we have norms and rules that we have to follow." (Group recall – Technicians)

As an innovative organisation, BOSCH TERMOTECNOLOGIA SA gives a great importance to R&D having a department with 50 workers with several types of knowledge.

> "In our business it is important to innovate, and I&D Department is always developing new functionalities and products. Some of these products and functionalities are not put into practice because they are too expensive or because, at that moment, it is not interesting for the organisation. This is all documented and can be used in another moment of the company's life." (Group recall – Department Managers)

Technicians think that R&D Department is very shut off. Although it integrates workers from different nationalities, they view it as "different world". Most researchers are new in the organisation and they are still in a learning process and it will take them 2 to 3 years until they can start producing visible results.

"I&D is a polar area of development in BOSCH Group." (Group recall – Technicians)

"We don't know what they are working on. Sometimes they come to the plant to make some kind of experiment, but we ask ourselves why do we need so many workers in I&D and what are they doing." (Operator from Production)

Knowledge application requires integration of different organisational knowledge areas and the integration of different and highly specialized knowledge related to the product or service delivery system.

> "When we implement an innovation, it is not just the R&D Department that is involved, but also Production, Engineering and Quality. All these areas have specific knowledge that is important for the product development." (Group recall – Department Managers)

Knowledge integration may lead to higher innovation levels, but sometimes the innovation is not successfully implemented and the knowledge itself is not necessarily applicable.

> "Sometimes the innovation doesn't work, but we continue on trying - R&D Department are always in a process of creating innovations. 'The error is a learning process'. As we know, a great deal of innovations are developed based on trial and error. The important thing is that this is a very important process of learning." (Group recall – Department Managers)

When innovations based on tacit knowledge are successfully implemented, they are more effective in creating a sustainable competitive advantage than innovations based on explicit knowledge, since these are more difficult for competitors to imitate. Tacit knowledge is more inimitable because it cannot be articulated clearly to others and requires personal experience. Competitors have difficulty in interpreting tacit knowledge without active participation in its development, implementation or operation.

Even within the organisation, tacit knowledge transfer and integration is conditioned by its complexity and because there are factors depending on the source/receiver of knowledge that affects knowledge integration.

> "What makes employees share and use shared knowledge is the communication between supervisors and employees. These activities can be beneficial and can help the job performance" (Group recall – Department Managers)

Therefore, it is necessary to develop new techniques that improve knowledge communication and integration by providing new forms of knowledge sharing through workers' relationship.

c) Implementing practices from other organisations

Corporations have always had some process of synthesizing their experience and integrating it with knowledge acquired from outside sources (e.g. inventions, purchased patents). A corporation acquires knowledge after years of experience in such areas as manufacturing, sales, and services. This cumulative experience from different departments, together with information gathered from outside sources, can be integrated and new practices or processes can be implemented in order to increase productivity.

BOSCH TERMOTECNOLOGIA SA visits others organisations (both within the BOSCH Group and external organisations) and copy their practices whenever it seems important to improve their quality and productivity, specially practices from the BOSCH Group.

> "We visit other organisations, especially inside BOSCH group. However, we have already visited AutoEuropa." (Group recall – Department Managers)

Operators point out the fact that all new practices and production process were inspired from other organisations.

> "When we think it's important to implement other practices we do it, even the BPS principles are inspired in the Toyota Production System." (Group recall – Operators)

Production Managers point out the organisational advanced stage of BOSCH TERMOTECNOLOGIA SA, despite the fact that there is always room for implementing new practices from external origins, especially from Universities (mainly from Aveiro University).

> "There are always practices that we can use as an advantage, but Bosch Termotecnologia SA is a step ahead from other organisations.
>
> If we had the same conditions as AutoEuropa, we could make great improvements in BOSCH TERMOTECNOLOGIA SA. If our technology was more advanced, we would increase our productivity and our profits. But our equipment is 50 years old and we have production lines, while AutoEuropa only has assembly lines.

> There is always somebody that brings new ideas to the organisation. For instance, the I&D Department has been recruiting people from the University." (Group recall – Production Managers)

Other important aspect is the integration of knowledge and practices from other departments of BOSCH TERMOTECNOLOGIA SA.

> "Each department has specific rules and procedures, and different ways to solve problems. Good practices can be copied and implemented from one department to another and the mobility has that goal – people in a mobility scheme carry good practices from one place to another.
>
> My experience is an example. I was a customer of the department where I am now, and when I arrived at this department, I had already identified what was done unnecessarily. But knowing the problems thoroughly has many positive and negative points.
>
> This type of attitude is not always understood – identifying negative points in a situation or trying to improve something that seems to work alright is a very difficult process.
>
> People who can adapt more easily to change can develop themselves; people that are resistant to change aren't rewarded by the organisation." (Group recall – Middle Managers)

BOSCH TERMOTECNOLOGIA SA is a very innovative organisation and they receive more visits from other Portuguese organisations. This reflects its high organisational and technological level.

> "We have more visits to BOSCH TERMOTECNOLOGIA SA then from BOSH to other organisations. BOSCH TERMOTECNOLOGIA SA is a leader in this business segment ant we don't have competitors at process level." (Group recall – Department Managers)

Production Managers have triggered the need to pay more visits to other organisations.

> "We visit other organisations, but it should happen more often. In the past we have visited Yasaki, AutoEuropa, a plant of Bosch Group and also some supplier's plants." (Group recall – Technicians)

Technicians focus the fact that all organisations that belong to the BOSCH Group have the same principles and practices and this facilitates the workers' mobility.

> "If we went to work in another plant of the BOSCH Group, in the same type of workplace, we could start today because the principles are the same and the type of organisation is similar either in Portugal or in Germany." (Group recall – Technicians)

Production Managers also point out the gap between BOSCH TERMOTECNOLOGIA SA and most of Portuguese organisations because the latter have very traditional practices, they are very centred in the CEO figure and there is no delegation when it comes to decision making.

> "The gap between Portuguese companies and Multinationals is enormous. In this context, some of our suppliers try to learn from us and we help them with auditorships, we allow them to visit BOSCH TERMOTECNOLOGIA SA's plant and we share with them our practices and knowledge." (Group recall – Production Managers)

The company is not afraid of potential competitors because their workers' tacit knowledge is a big value for the competitiveness of the organisation.

> "The competitors can know how our process functions, but they don't have our workers' knowledge and experience. BOSCH TERMOTECNOLOGIA SA has reached a stage of progress that is difficult for the competitors to get to, mainly because we are always changing and the employees of the organisation have already interiorized this culture of change.
>
> It is possible to copy the philosophy, but they cannot copy the Operators' knowledge. The individual knowledge is not easy to transfer. It can be transmitted, but the assimilation process is more complicated." (Group recall – Department Managers)

5.2.6 BOSCH TERMOTECNOLOGIA SA Research Box

Organisational innovation and knowledge sharing is supported by BOSCH TERMOTECNOLOGIA SA Managers' attitudes, workers' involvement, and the reward systems that induce knowledge sharing.

5.2.6.1 Knowledge Sharing Culture

To support and encourage the use and share of tacit knowledge and to underline the impact in the innovation process, BOSCH TERMOTECNOLOGIA SA Managers try to create a working environment with different thinking styles and without penalties for failure, which discourages experimentation. They also encourage an open culture, having less formal relations.

Top management communication about the importance of knowledge sharing and the operationalization of this idea by Managers, who do regular knowledge sharing

sessions in communication corners, is the crucial factor for BOSCH TERMOTECNOLOGIA SA knowledge sharing culture.

To make the process of knowledge sharing work and become effective, BOSCH TERMOTECNOLOGIA SA has been promoting trust among workers and between workers and Managers, making workers more participative and more involved since BPS implementation.

On the other hand, Managers use coaching techniques to promote workers' participation which have eliminate barriers in creating and sharing individual knowledge. The coaching process assumes a critical role because no matter how explicit and well defined the rules and routines are, there will always be some element of ambiguity or uncertainty creating the need for analysis and comprehension, especially in BOSCH TERMOTECNOLOGIA SA plant because Operators with less qualifications have difficulties in understanding some of the displayed information in the plant.

Knowledge sharing is often based on the organisation of explicit knowledge. In BOSCH TERMOTECNOLOGIA SA there are procedures sheets and knowledge databases for problems and solutions related to quality management. Others repositories are used to store information and documents that can be reused and shared like, for example, product specifications, manuals and other information regarding production.

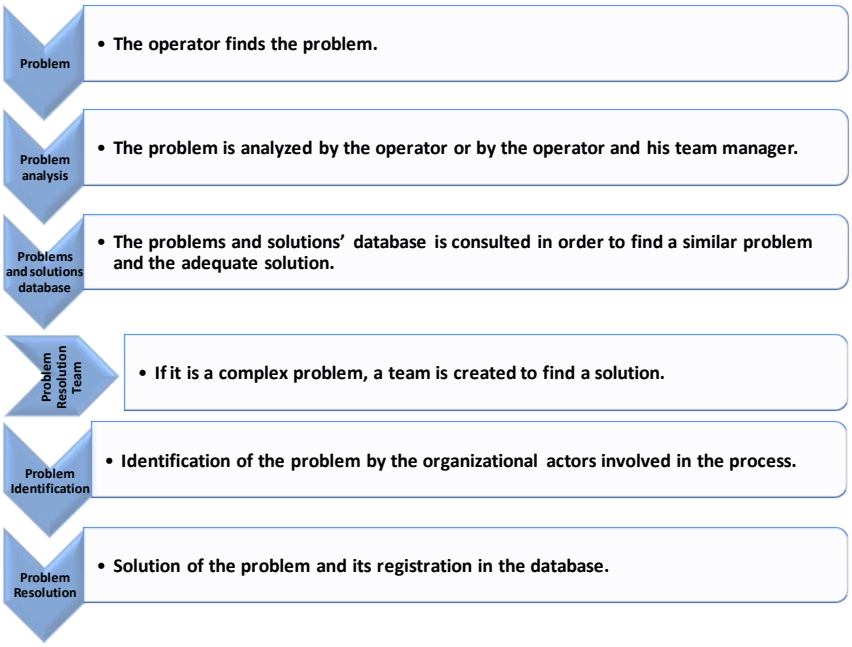
One of BOSCH TERMOTECNOLOGIA SA's management main concerns is to store and codify rules and procedures in a simple format so that employees can easily access and understand them. If rules and procedures are not stored and written clearly, each employee is likely to follow his/her own interpretation of the rules. When rules and procedures are clearly marked down, there is far less ambiguity in understanding and interpreting those rules and procedures. The BPS process of automation and standardization of tasks and schedules is a mean of handling this situation.

On the other hand, problem-solving approach creates a high level of interaction and the closeness and the trust among workers is the key to the degree of tacit knowledge shared. Most problem situations are solved in an unconscious way, automatically and in a few seconds. Other situations require more time, effort, teamwork, collaboration and extensive abstract knowledge.

In BOSCH TERMOTECNOLOGIA SA, depending on the complexity of the workstation, the Operator decides if he has the knowledge and the tools to solve the problem or if he needs help from Managers. If the problem is too complex and he does not have autonomy to decide about the problem solution, he then informs the Shift Manager that evaluates the nature of the problem.

BOSCH TERMOTECNOLOGIA SA's routine in creating and using knowledge in problem solving process began with the problem-finding phase; then the problem is analysed by the Operator and/or the shift Manager. If they cannot solve the problem, they consult the quality database where they store all problems and solutions. If the problem is too complex, they created a team to solve it and when they find the solution, they implement it and register the problem and the corresponding solution in the database.

Figure 11 – Problem-solving process: routine in knowledge creation and use



BOSCH TERMOTECNOLOGIA SA has several routines to create and share knowledge and BPS imposes a constant creation of new knowledge, especially regarding the organisational innovation process.

The innovation process is a key factor because of the importance of implementing new ways of production and new organisational processes to accomplish higher efficiency. Involving workers in this process requires the use of management tools such as communication and the promotion of workers' involvement and participation. BOSCH

TERMOTECNOLOGIA SA uses several mechanisms to promote knowledge share and develop new ideas. It's important to point out the suggestions system (mainly used to make production improvements), the workshops on innovations and new products, and the knowledge networks (specially the informal ones).

Looking for another perspective, we can say that BOSCH TERMOTECNOLOGIA SA is a learning space at a technical and organisational level. One of the most effective tools to create and disseminate knowledge is though workshops with people from different sections or people from just only one section.

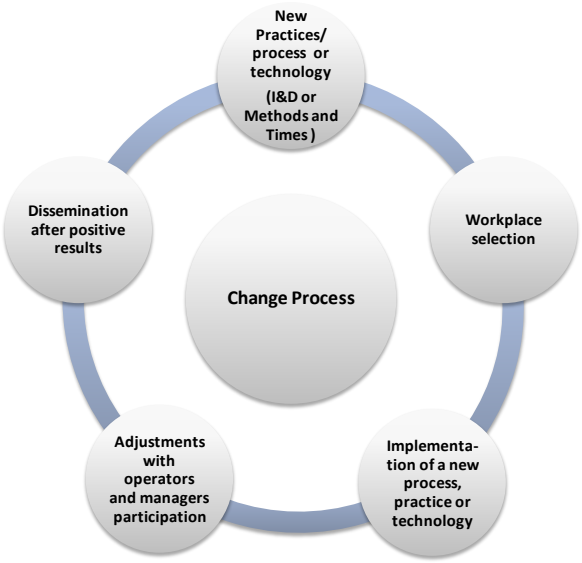
Costumers and external specialist often participate in the workshops and help the discussion and the creation of new knowledge that helps implement new practices, tools or technology.

The workshops in BOSCH TERMOTECNOLOGIA SA can be seen as knowledge creation and sharing processes, like the communities of practice or other processes of linking workers to others with expertise. Relational competences are a key to the capture, use and creation of new knowledge and learning within BOSCH TERMOTECNOLOGIA SA.

The participation of all organisational actors in BPS process helps to develop a more consistent knowledge-sharing culture. Employees share ideas and insights naturally and not as something they are forced to do. There is a connection between sharing knowledge and achieving the business goals or solving practical problems.

In BOSCH TERMOTECNOLOGIA SA, the knowledge sharing process among sections and workers is very peculiar. They implement a new practice, process or technology in one specific workstation according to the Operator's openness to change. When it is working perfectly and new and better results are achieved, they share this new knowledge to other workers and transfer it to their workstations, disseminating the new knowledge along the plant.

Figure 12 – Knowledge sharing in a change process at BOSCH TERMOTECNOLOGIA SA



Competencies' development also helps to create a culture of knowledge sharing and BOSCH TERMOTECNOLOGIA SA has several training routines. The main goal is to create a potential - they invest in their workers so they can assume more responsibilities and become more knowledgeable.

Training assumed a big importance when BPS began to be implemented because everything was new: new principles, new practices, and new processes. This was the critical point of change. At that moment, the knowledge sharing performed a nuclear role, not only to disseminate knowledge about the system, but also to reduce resistance.

The next figure shows the main ways of learning and sharing knowledge by BOSCH TERMOTECNOLOGIA SA's employees. They share knowledge with their colleagues in several different and systematic ways creating opportunities to learn and maximize the organisation's ability to meet their needs and generate solutions and efficiency that provides the business a competitive advantage.

Figure 13 – BOSCH TERMOTECNOLOGIA SA as a knowledge organisation:

Embedding a culture of knowledge sharing and reuse is perhaps the most important challenge for BOSCH TERMOTECNOLOGIA SA Managers. It is less about managing knowledge and more about managing workers whose work depends on what they know and what can learn from others.

5.2.6.2 Impacts of Individual Knowledge on Organisational Dimensions

Workers are always making suggestions and giving their opinion about new practices, which has a huge impact on organisational routines.

a) Human resources practices

As we can see, the responses about human resources practices are very high, except when it comes to the impact of the reward system. The knowledge sharing process has great impact, especially *Practices of information transmission, Competencies of workers and Managers* and *in the recruitment of new workers*.

Practices of information transmission	100%
Workers' competencies	87,5%
Managers' competencies	87,5%
Recruitment of new workers	87,5%
Motivation levels	75%
Performance Levels	75%
Reward Systems	25%

Practices of information transmission: the organisation had a change in terms of sharing ideas in the meetings and through all the information displayed throughout the organisation (the new organisation chart, the new mission, goals and strategy, and also the technical information that circulates on files).

Workers' competencies are a main concern, since not only are the technical competencies developed, but also behavioural competencies. BOSCH TERMOTECNOLOGIA SA has a training centre where Operators can also develop their formal competencies.

Recruitment of new workers refers mainly to temporary workers and sometimes this brings some difficult situations, not only because of their integration, but especially

when the contract is finishing and their work influences negatively the team's productivity.

Performance Levels have increased because of the new work practices introduced by BPS. For example, 5 S´s, CIP (Continuous Improvement Process), TPM (Total Production Management), TQM (Total Quality Management) and others.

Motivation levels had increased with the new culture of participation and knowledge sharing through the workshops, the new ideas development system (suggestion boxes), and because most workers really like to work at BOSCH TERMOTECNOLOGIA SA.

Manager's competencies development helped them to coach and to develop their subordinates since the BPS implementation.

The new *reward system* has always been better when comparing it with the sector reward system.

b) Training

In the training process, the organisation has benefitted from the knowledge sharing routines, especially because of the *Major adequacy of training to organisational needs* and *Specific technical training*.

Major adequacy of training to organisational needs	100%
Specific technical training	100%
Participation in the diagnostic of training needs	75%
Behaviour training	75%
Innovation training	75%

Major adequacy of training to organisational needs has to do with a lot of training sessions dedicated to the production and the new practices implemented in the plant.

The *Specific technical training refers to* new technologies acquired to improve production and the new production practices implemented.

Participation in training needs' diagnostic identifies each person's specific needs for competencies' development.

Behaviour training was intended to help Operators interact with their clients, to treat them with respect and to communicate effectively. Training associated to the 5S

principles and BPS principles aimed at helping workers to assimilate the new ways of working.

Training in innovation refers to the technical innovations developed by the R&D Department.

c) Work organisation

In the work organisation, the level of responses are also very high, involving all hierarchical levels, and only *Project teams* and *Services' externalization* got very few responses.

Total Quality Management Programs	87,5%
New work processes	87,5%
Increasing planning processes	87,5%
Self Quality Control	75%
Increasing dialogue	75%
Semi-autonomous teams	75%
Network	62,5%
Project teams	12,5%
Services' externalization	12,5%

Total Quality Management Programs were implemented with the definition of problem-solving routines and quality standards.

Project teams is a concept which is not very clear in BOSCH TERMOTECNOLOGIA SA. Nevertheless, they work in teams in each section of the plant.

New work processes are linked with BPS principles and all the new and continuous change in the work organisation and development.

Network refers to the informal relationship among workers and Managers in order to solve all the emerging problems and to find their specific solutions.

Self Quality Control has increased because of the new management practices and quality standards.

Increasing planning process through BPS instruments with the ultimate goal to reduce costs and to increases productivity.

Increasing dialogue with the creation of the communication corners, the realisation of the workshops and with the visual management procedures.

Semi-autonomous teams refer to team's autonomy to solve some problems according to the workstation complexity.

Services' externalization is only used when the organisation does not have the competencies needed to develop the work.

d) Organisational structure

According to the Organisational structure, only some of the Operators have answered that there was a change in the *New hierarchical levels* and in the *New organisational units*.

Decision making decentralization	62,5%
New hierarchical levels	25%
New organisational units	25%

Decision making decentralization was achieved through the implementation of the semi-autonomous teams.

New organisational units have not been created and *New hierarchical levels* have not changed.

e) Technology

It was mainly the Managers and Middle Managers that answered that there had been *Acquisition of new information and communication technologies* and *Acquisition of new production technologies*.

Acquisition of new information and communication technologies	62,5%
Acquisition of new production technologies	50%

Acquisition of new information and communication technologies in office automation.

Acquisition of new production technologies to increase productivity.

f) Product development

It seems that some of the Operators don't see any change in the products' technical characteristics.

Technical characteristics	62,5%
Design	50%
Packaging	25%

Technical characteristics have specifically increased the quality of the projects.

Products' *Design* make them more modern and gave them style.

Packaging does not seam to be relevant in Thermotechnology.

g) Market

Operators do not seam to be aware of the organisation's *Market Share* and its exploration of *New Markets* worldwide

Product and services quality	75%
New markets	50%
Market share	50%

Product and services quality have increased with the TQM and 5S´s systems.

New markets refers to entering into the USA market.

Market share has been increasing since 2000.

h) Process

According to all participants' opinion, there has been an *Increase of production capacity* deriving from the organisation's knowledge share culture, and also an increase of *Production flexibility*.

Increase of production capacity	100%
Production flexibility	87,5%
Work cost	62,5%

The *Increase of production capacity* is due to the continuous change in the work and organisation practices.

Production flexibility increased with the semi-autonomous teams and with the competencies matrix system implemented in the plant.

Work coast decreased especially due to the waste reduction and with the new stock management system.

i) External relations

There was a high number of answers that pointed to the *Increasing relations with suppliers* and *Increasing relations with other organisations and community*. Operators do not point out the *Increasing relations with clients* because they don't have a direct contact with them.

Increasing relations with suppliers	87,5%
Increasing relations with other organisations	75%
Increasing relations with community	75%
Increasing relations with clients	50%

Increasing relations with suppliers got high marks because of the quality standards and because of costs reduction.

Increasing relations with clients was attained by making them participate in the innovation process, and by the quality of post-sales support services that helped them solve problems with the equipments.

Increasing relations with other organisations and the community applies mainly to university developing Innovation Projects (namely the Aveiro University) and to the community's donations.

j) Employee participation

Almost all participants answered that there was a high level of workers' participation in the organisational life.

Improvement suggestions	100%
Meetings	87,5%
Technical problem solving	75%

Improvement suggestions through the suggestions boxes and directly to the Managers.

Meetings in the communication corners to discuss the problems and to discuss the new changes.

Technical problem solving routines are increasing and being improved to help solve the problems in lesser time and with less production costs.

k) Knowledge management

Operators and some Technicians don't have the perception about the existence of a *Knowledge network* or *Best practices repositories*. Perhaps because they do not have computer access in the organisation.

Knowledge network	50%
Best practices repositories	50%

Knowledge network refers mainly to informal networks to solve problems.

Best practices repositories in databases that can be used for other sections or departments of BOSCH TERMOTECNOLOGIA SA.

l) Management practices

The *Quality management* and *Human resources management* are practices that almost all participants considered to have changed for the better with the knowledge sharing culture of the organisation.

Quality management	87,5%
Human resources management	75%
Project management	25%

Quality management is in implementation, defining the quality standards and implementing routines to help quality problem solving.

Human resources management with the performance appraisal of training needs, the competencies' matrix, and the mobility system that helps to develop workers' competencies.

Project management is still to be implemented as a merely management practice.

5.2.6.3 Analysis and Reflections

BOSCH TERMOTECNOLOGIA SA began the whole innovation process by implementing the Bosch Production System, a very structured system with several tools adapted to all organisational dimensions.

One of the critical factors of success is the top management involvement in all the processes, and the willingness to create and implement a culture of innovation and change. This culture is being created on a daily basis, creating habits and behaviours of participation, communication and involvement in all aspects – this constant change involves both micro and macro changes.

During the *group recall* sessions, almost all the actors have made some kind of suggestion of change, not only involving their workstations, but also the organisation itself. This culture of innovation and participation is deeply integrated in BOSCH TERMOTECNOLOGIA SA's organisational life.

When we analyse the routines for creating and sharing knowledge, we can find several mechanisms used to facilitate the share: suggestion boxes, openness to make suggestions to the Managers, several types of workshops where employees from different sections participate, and several transversal projects of improvement, quality and maintenance.

With great visibility, BOSCH TERMOTECNOLOGIA SA's workers use the suggestion boxes as a space where they can uncover new ideas that help improve the organisation.

Cross-functional workshops and meetings are a crucial space to share perspectives and to make discussions that provide invaluable knowledge. Organisational actors share their opinions and insights, as well as their own questions, sharing and creating new knowledge. For added impact, outside specialists and even costumers participate in these sessions. Their perspectives can be refreshing and break down the thinking routines of internal workers.

Transversal projects like TPM or projects related to quality systems also help to develop workers' competencies with the share of their knowledge and experiences.

Like Reid argued in his research that "the most effective way to disseminate knowledge and best practice is through systematic transfer" (2003). BOSCH TERMOTECNOLOGIA SA has been creating a culture of knowledge sharing by implementing these routines and promoting collaboration in a systematic transfer.

To potentiate this collaboration, BOSCH TERMOTECNOLOGIA SA uses collaborative problem-solving techniques. The problems encountered in BOSCH TERMOTECNOLOGIA SA were consistent with Billett's (2001) distinction between routine and non-routine problems.

a) *Routine problems* involve situations that have been experienced before:

- *Simple, repetitive and well-understood situations*, which are handled in a tacit mode, with very little conscious thought. The simple nature of these situations allows for easy explication. This happens with BOSCH TERMOTECNOLOGIA SA quality problems.

- *Routine situations within a different context*, when workers face problems that are similar but are not exact repetitions of previous experiences. As routine problems become more complex, the capacity to address these situations depends on the ability to quickly recognize and diagnose the problem. In BOSCH TERMOTECNOLOGIA SA when workers face this kind of problem and it seems to be impossible for them to solve them on their own, the problem is reported to the Manager.

b) *Non-routine problems* need workers' knowledge to solve novel problems that may represent their most valuable contribution.

- *Solving novel problems* need workers' ability to define the problem and to work collaboratively with others employees from different sections to find a solution. In BOSCH TERMOTECNOLOGIA SA when a novel problem occurs, a team from different sections tries to find the solution.

- *Emergent problems* can be described as workers proactively identifying problems to explore or process improvement or new work situations. In BOSCH TERMOTECNOLOGIA SA workers use the suggestion boxes to solve emergent problems.

— *Solving problems outside of expertise:* these are problems that are unique and outside of their existing domains of experience and expertise. In BOSCH TERMOTECNOLOGIA SA we can find these problems related to some equipments that may need the supplier's expertise.

All these problems are discussed in the communication corners along with all other aspects of organisational life. This not only promotes the share of ideas and opinions, but it also illustrates the importance of developing effective communication and consultation processes to overcome cultural and attitudinal obstacles to change. The need for all organisational actors to be informed about the need and purpose of the organisational innovation process is emphasized in this case.

Knowledge transfer is particularly important when workers join the organisation. More employers should be proactive in the way they manage employee's succession. When succession occurs, the new incumbent of the role must be helped to "hit the ground running" through a defined process of knowledge transfer. Ideally, there should be a period of "shadowing" or a series of handover meetings to aid effective transition. At the very least, the organisation must have a structured way for identifying the core knowledge required for the role and ensure that the new incumbent is at ease with it.

BOSCH TERMOTECNOLOGIA SA uses the performance appraisal as a management process and an opportunity for knowledge sharing between Managers and workers. Both parties draw together key lessons, and Managers in particular identify key points for further learning.

To show its commitment for sharing knowledge, BOSCH TERMOTECNOLOGIA SA created a reward system taking into account workers' contribution and their participation in the organisational life. The reward system was created to benefit workers who contributed to and used a shared knowledge base. Their contribution is also recognized through information displayed in the plant.

Finally, it's also important to stress the importance of the sharing during the training programs that have prepared Managers and workers to work within the new set of organisational dynamics imposed by BPS.

5.2.7 BOSCH TERMOTECNOLOGIA SA Research Conclusions

BOSCH TERMOTECNOLOGIA SA's organisational innovation process began with the implementation of 5S management system and with the BPS implementation. The change was top-down supported in the knowledge sharing processes through top management's attitudes, employees' involvement, the reward system's contribution in inducing knowledge sharing, and informal knowledge networks in problem-solving situations.

The main goals of BPS is to improve productivity and quality, and increase teams' performance. To support these goals, BOSCH TERMOTECNOLOGIA SA implemented human resources policies (for example, management by goals and competencies, reward system, training programs, internal mobility) to encouraged knowledge sharing in order to create a knowledge sharing culture.

Department Managers create conditions for workers to see direct benefits from sharing their individual knowledge to their co-workers and Managers. The effective use of workers' knowledge by the organisation (by implementing the workers' suggestions, for instance), is one of the most effective ways for workers to notice their contribution to increasing the organisation's performance, and to make them see that this can benefit themselves and their co-workers.

Production Manager's attitudes and actions influence the way knowledge sharing is perceived by employees. By arranging periodic meetings among teams in the communication corners, they provide feedback and discuss the new changes implemented in the plant. Communication is supported with data from the team's performance and results. This information is displayed in the communication corners and focus on productivity, performance and production quality.

Middle Managers adjust and integrate individual knowledge into norms and organisational procedures in real time. They train the workers to transform individual knowledge into organisational knowledge and have the support of top management and the freedom to make decisions and implement procedures.

Technicians promote the social interactions across the plant's sections trying to involve Operators in the changes, bringing them to share their knowledge and taking their ideas to implement the change or to highlight new possible changes to make things work better.

Operators integrate the new knowledge created, and also use their knowledge collaborating with their colleagues. BOSCH TERMOTECNOLOGIA SA's Operators have the opportunity to participate in several cross-functional projects and share knowledge more deeply.

Finally, the findings we made during the research process helped us realise that the organisational actors – Operators, Technicians, Middle Managers, production Managers and Department Managers – had similar perspectives about the organisation and especially about the creation and transfer of knowledge processes.

5.3 EFACEC Organisational Innovation Project

Innovation and change is a predominant factor in the management of organisations and if an organisation "is not growing, not changing, not meeting the current needs of society, and preparing to meet its future needs, it is declining" (Higgins and Vincze, 1986, p. 29).

5.3.1 Action Research in EFACEC

The empirical research started in the autumn of 2005 with several contacts with the innovation office manager and a meeting in EFACEC (General Headquarters), beginning the exploratory phase. In this meeting, the innovation office manager explained me the ongoing organisational Innovation Project. Several other contacts were made and EFACEC became interested in knowing what kind of impacts had resulted from the knowledge shared in the innovation project in Robotics Business United.

The instruments used in the group recalls and in the interview were sent to the innovation office and accepted without any suggestions of change.

In the spring of 2006 we began the research with the groups recall process. Later, in the winter of 2007, other data was collected.

Regarding the groups recall, two were made with the Technicians and one with the Managers (head of departments). There was also an interview with the General Manager of the organisation.

All the groups' participants where selected by the Innovation Office Manager and the General Manager of EFACEC Automação e Robótica.

The groups recall were conducted by the researcher, recorded on video tape, written down, interpreted and analysed. The interviews were semi structured with the support of an interview guide.

The main goal was to collect opinions, values and behaviours of the different actors about the innovation and change process.

When we started the group recall, some of the participants were sceptic about the process because they though that some people could feel intimidated and not talk at all, but everyone participated with their opinions, experience and examples related with their everyday work.

In the end, some of them told me that this process was very interesting because they focused more easily on the question's main goal, and at the same time, they answered questions using different perspectives. They also told me that it was easier to remember some details and examples when they were listening to their colleagues.

Another good thing was that listening to their colleagues' experiences made them become more aware of other department practices, and the existing relationships between their colleagues and their Managers.

Some of the group practices and potentialities were also discussed in the meeting, and sometimes I saw them discussing a detail, as if they were alone, with no interference of the researcher.

I think that the group recalls helped the participants to know each other better and to know the organisation in which they worked. This was more significant with the Technicians, because they did not have intradepartmental meetings at that hierarchical level.

With the Managers, this was not so relevant because since the organisational Innovation Project they had implemented meetings every 15 days, where they discussed not only technical issues, but also organisational ones.

5.3.2 Contexts of Organisational Innovation Process

EFACEC Group is the biggest Portuguese electromechanical group, with experience in diverse international markets. The Human Capital (3.500 people all over the world) constitutes the most important asset in EFACEC, being leader in the supply of

integrated solutions and equipment goods for the market of the production, transmission and distribution of energy.

This area of expertise is the result of the aggregation of abilities of seven companies who constitute an integrated chain of value, beginning in the project definition, to the production of equipment and the conception of integrated solutions, dawn to the measure of the customers' needs.

It also contemplates the rendering of Assistance and Maintenance services. The Group has covered the following areas:

- Production of Energy
- Transmission and Distribution Systems
- Automation and Telecontrol Systems
- Feeding Systems
- Assistance and Maintenance Services

EFACEC Automação e Robótica, S.A. is one of the seven companies and its activity is centered in Industrial Logistics and Airports Logistics, having a wide experience in robotic systems.

Its activity is also centered in automated logistic systems. The preference for the EFACEC, Automatção e Robótica by the international market is because of its technological capabilities and to the high degree of equipments' customization, both of which are crucial and determinative factors for its success.

In 2003 EFACEC Group began the "EFAinova" Project as an example of its concern in creating propitious environments to the development and active participation of its workers in project management, and in creating conditions for the development of mutual trust, participation and responsibility share in organisational results. One of the companies that have implemented EFAinova project was EFACEC, Automação e Robótica.

This is a project of organisational innovation implementation that presents a set of actions that will lead to a change process. The department of innovation has begun the process, but the Technicians and the Managers of the unit are responsible for its implementation.

The Innovation Office team is the one who began the process's kick-off using a specific methodology based on workshops where both workers and Managers of the business

unit met and worked together, independently of the hierarchical position. New ideas were born trough a structuralized brainstorming process. Some of the results were orthodoxies, discontinuities, customers' needs, and business' key competencies.

After this process, all the data generated was analyzed and systematized giving origin to (what they call) "dominions", or a "complementary family processes" that translate a common benefit in time (Ef@news, November 2003).

Then the business unit decided to carry out the change process, defining what kind of organisational innovation was more adequate to help them become more competitive.

The business unit was responsible for the implementation process and an essential factor for its success was the involvement and support of top management, since this had already been proven when this methodology was applied to other EFACEC business units.

a) The changes introduced

Analysing the **type of organisational innovation** according to OCDE (2002), which we already done before with the BOSCH TERMOTECNOLOGIA SA case, EFACEC, Automação e Robótica is working on:

First axis - restructuring production and efficiency processes, business re-engineering, flexible work arrangements, greater integration among functional lines, and decentralization.

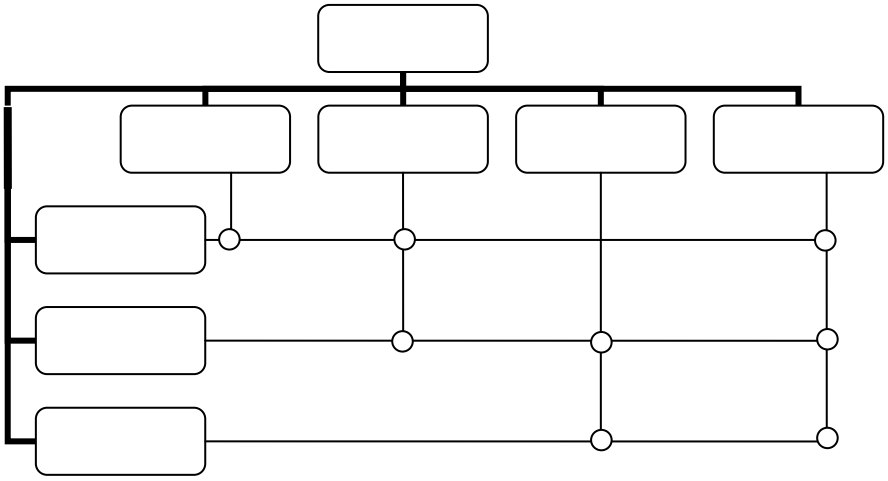
Second axis - human resource management practices, flexible job design, employee involvement, and improving employees' skills.

Third axis - product/service quality-related practices, total quality management and improving coordination with customers/suppliers.

EFACEC, Automação e Robótica introduced the following organisational innovations:

- Organisational Structure: a new structure based on project management with a matrix configuration that replaced the functional organisation;

Figure 14 – New Organisational Structure of EFACEC, Automação e Robótica



- Processes: operational processes were optimized in order to meet the complexity and technical specifications demanded by the type of business they developed;
- Teamwork: the working teams (that already existed in the early structure) have been set up according to the new work organisation processes that were implemented. These teams now have Engineers and Informatics Technicians that work in projects for national and international clients. Their central mission is to provide technical services and to build specific products in the automation and robotic area. They also assure the quality of the operational processes. These working teams are self-organized since their roles, duties and tasks' organisation is their own responsibility. Team members can perform different tasks and activities, depending on the needs of the team itself. Moreover, team members have an important role in the design and validation of the working processes' structure;
- Communication: coordination within the team is the responsibility of a project Manager, who has regular meetings with the board of directors to discuss team performance and the ongoing projects. These meetings have an important impact on the new culture that is being implemented: management by goals;
- Rewards: EFACEC, Automação e Robótica is setting up an incentive system according to the results generated by these working teams. This system is connected to the Balanced Score Card, with several quantitative and qualitative indicators;

- HR Management Policies: to reinforce and consolidate organisational changes, EFACEC, Automação e Robótica implemented complementary performance appraisal and reward policies. These help to improve worker motivation and aid the employees' capacity to participate in the organisational development of the company. They also promote a shared and accepted perception of personal and professional equity and development throughout the organisation;
- Training: during the organisational Innovation Project, new training sessions have been set up. In the annual performance appraisal, they diagnose and evaluate competencies, and identify personal development needs. They form a training plan but most of the times they cannot follow the plan because of business constraints. The employees work outside the organisation in clients' projects and this limits their attendance to the programmed training sessions.

EFACEC has also made complementary investments in ICT to set up a software and hardware development programme that would meet the new goals of the organisation and in order to produce and store information. However, this information is not disseminated throughout the entire organisation. This will be the next phase: to improve the communication processes among their employees and working team groups.

b) *Nature of Organisational Innovation and Change*

The organisational innovation and change were implemented incrementally (Imai, 1989) because they are improving the organisational processes and it is also planned. The process was guided by management as a path to lead the organisation from a less favourable state to a more favourable state. They had a fist phase of preparation and now they are in the phase of implementation; the next phase will be the reinforcement of innovation and change in the organisation.

c) Roles and Responsibilities

The commitment of top management was very important, not only for the whole process of creation and sharing of knowledge, but mostly for its effective use and application.

However, they are not questioning their existing ways of doing things and proposing changes in operational processes in order to improve operational efficiency. Also, the organisational climate is not in good shape: an inquiry has been carried out and the results show that people are not yet satisfied with the working conditions, specially the

ones associated to the rewarding system. This led us to the barriers that emerged during the organisational innovation process.

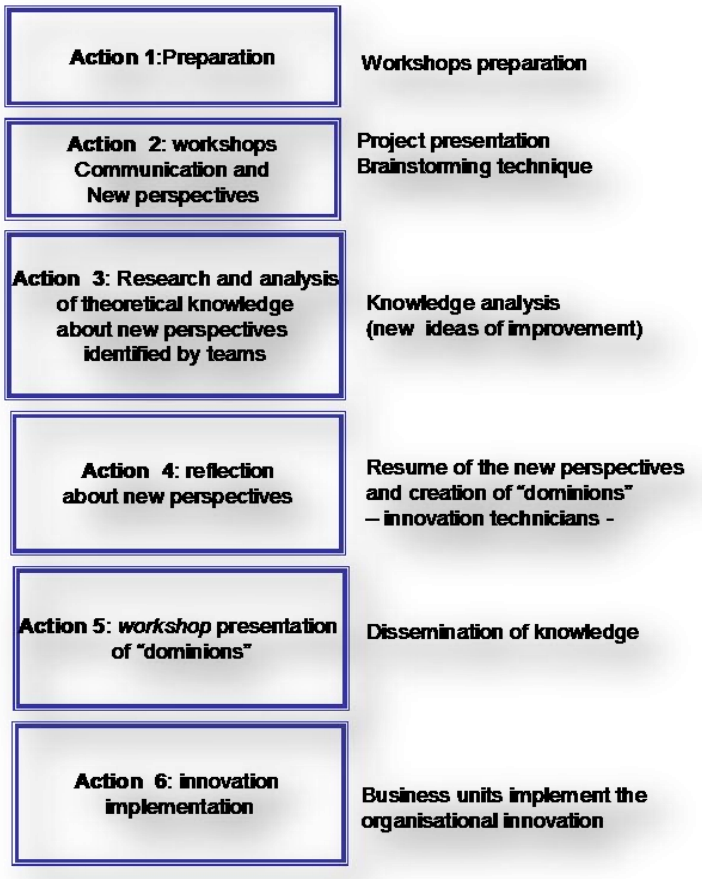
d) *Origins of Organisational Innovation and Change*

The idea of the innovation and change project came from outside from the Efacec and Robótica, beginning with the EFAINOVA project developed for the EFACEC group and involving some of the Business Units of the group and external consultancy companies.

This project began with an idea that emerged from “Forum de Inovação” - Group José de Mello. This economic group now holds a large share of EFACEC.

A consultancy company developed the methodology and the Innovation Office used itI in the Innovation Project of EFACEC, Automação e Robótica.

Figure 15 – EFACEC, Automação e Robótica: Innovation Project Methodology



e) Barriers and Facilitators

The following barriers surfaced during the implementation of organisational innovations:

- Consultation with workers: the process was managed within a “top-down” basis. Even if there was a lot of communication with all the organisational actors, now some of them feel that the new organisational structure is different from the one they all had conceived during the workshops;
- Communication throughout the organisation: the organisational innovation process required employees to change traditional ways of doing things. However, some workers did not understand that EFACEC organisational dynamics had changed. Communication programmes failed to explain the main goals of the project, the role of each worker in the change process and its impact on the whole company.
- New culture and values: the lack of communication between Managers and Technicians slowed down the development of support for the change process throughout the organisation.

These problems were the result of a number of underlying obstacles to organisational reform within EFACEC, specifically:

- Lack of leadership skills: initial problems with Middle Managers highlighted the lack of key leadership skills in this group of organisational actors. The training sessions help them develop some skills necessary to facilitate the change process and to set up and support the implementation of the new structure and processes. The organisational Innovation Project was very important because it initiated the change process and helped create new knowledge to improve the organisation’s performance;
- Difficulty in overcoming existing culture and values: at the beginning, many employees saw the change process as peripheral to their activities. This was resolved when the company improved employee participation and involvement in the implementation process and in the validation of organisational strategies through the workshops;
- Resistance from employees: the innovation process was completely new for employees and individual fears produced some resistance at the beginning.

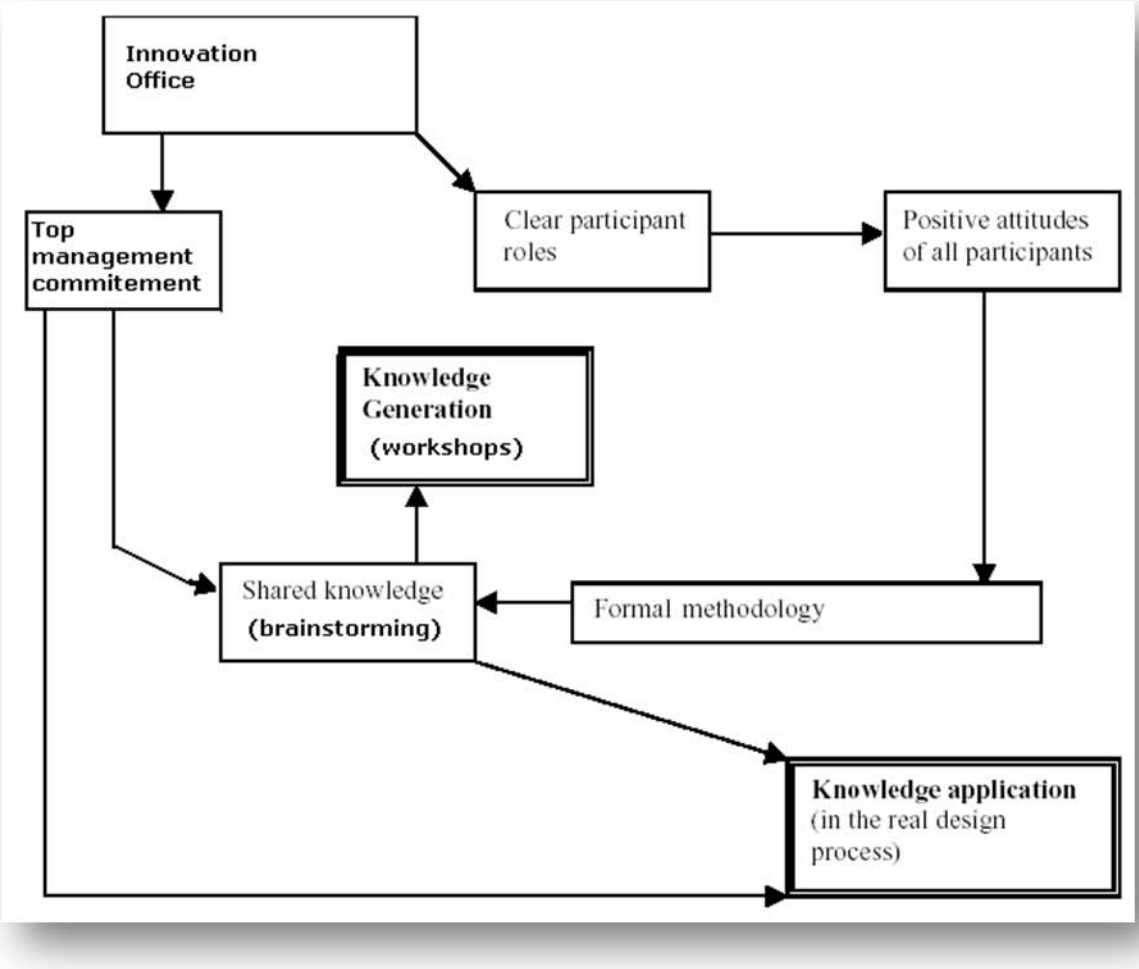
However, this resistance has disappeared with their involvement and participation in the process.

5.3.3 Creating and Sharing Knowledge During the Organisational Innovation Process

EFACEC, Automação e Robótica used workshops as an instrument to initialize the organisational innovation process and to create and share knowledge that could lead to improvements.

The following figure will show the process of creating, sharing and using knowledge in the organisational innovation and change project in EFACEC, Automação e Robótica:

Figure 16 – Creating Knowledge at EFACEC, Automação e Robótica



Some factors influenced the workshop process:

- Preparatory work: innovation Technicians in particular were very well prepared for workshops. In general, crucial information was available and accessible.
- Workshop formats: workshops limited in time also limited the knowledge sharing and time for reflection.
- Workshop process: the innovation office used consistent brainstorming approaches.
- Participation: the expectations of workshop's participants were fulfilled and all participants gave ideas and suggestions to improve the organisational performance.
- Commitment from Top Management: right from the beginning, top management participated in the whole process.
- Benchmarking: some of the practices used to conceive and implement the organisational Innovation Project were already used in another business unit of the organisation.

According to the knowledge creation process in the workshops, there are also some reflections to be made:

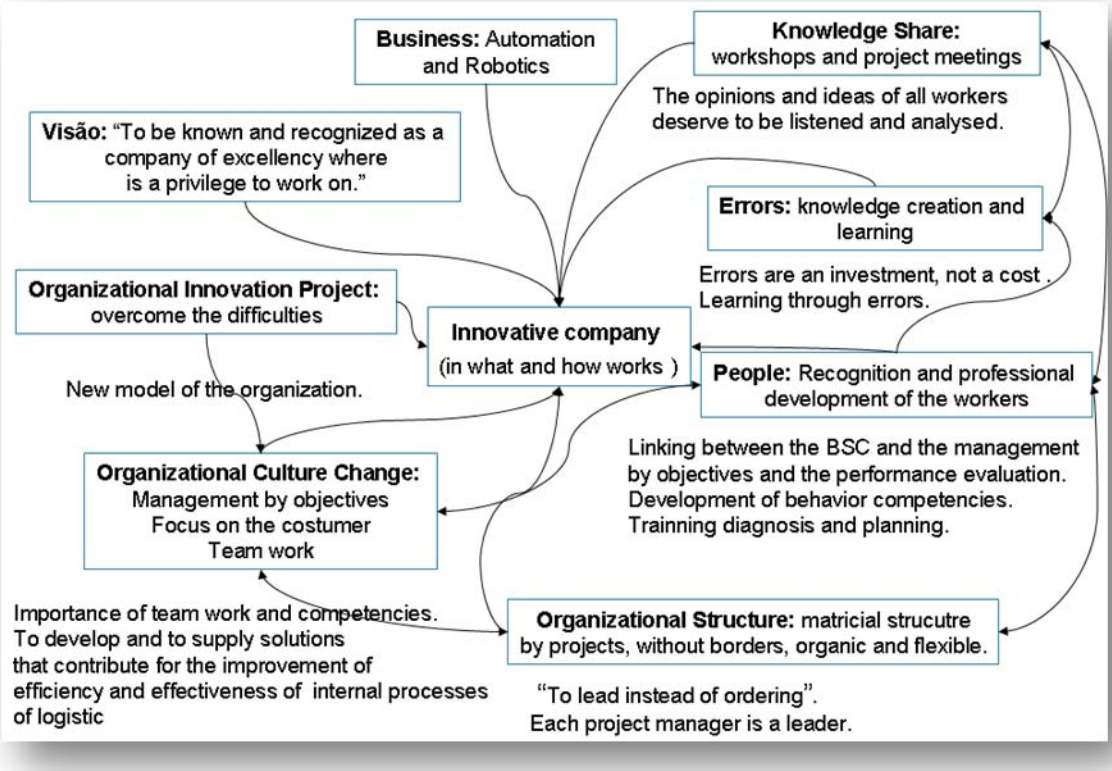
- Measuring effectiveness in a formal way was inhibited, as ideas and solutions were not quantified in terms of the financial savings or labour cutback. Moreover, there were not any formal mechanisms in the divisions studied to track the progress of the outcomes in terms of their implementation in the design process itself, and ultimately their impact on the Business Units and in the organisation itself.
- A report was produced for each workshop and recommendations were made by the innovation office.
- Dissemination was limited to the workshop participants and the documents were stored but not in an accessible repository. Some results were disseminated by the organisation's newsletter.

5.3.4 Organisational Innovation Dilemmas in EFACEC, Automação e Robótica – actors perceptions

5.3.4.1 Perceptions about the innovation process

The next figure represents the organisational and change process in Efacec, Automação e Robótica, showing the liaison between the key elements pointed out by the organisation's General Manager.

Figure 17 – Organisational Innovation and Change Project in EFACEC, Automação e Robótica



5.3.4.2 1st Dilemma

"Literature emerge the idea that the use of individual knowledge, accumulated through life and professional experiences, is a competitive advantage for the organisations' success. However, sharing and transfering inexpressible knowledge is almost an impossible task to accomplish."

a) Knowledge sharing and transference

In EFACEC, Automação e Robótica I found two major organisational routines of knowledge transfer: within-project tacit knowledge transfer, and post-project explicit knowledge transfer.

In the first one, the knowledge is transferred by the rotation of workers within projects. Teams change according to the project's development, the competencies needed and the existing human resources.

However, the tacitness of project development related knowledge makes it particularly difficult to transfer (Deyer & Nobeoka, 2000; Lynn, 1998). This has two major impacts: first of all, tacit knowledge is embedded in an individual's experience, in ideals, values and emotions (Nonaka & Takeuchi, 1995), and secondly, it can only develop in a professional context through the "art of the practice" (Schön, 1983), i.e. by performing the specific tasks. This would require some systems or mechanisms for sharing tasks and responsibilities like, for instance, job rotation practices.

In post-project explicit knowledge transfer, all project documentation is stored and if necessary made accessible. When another project begins, it becomes interesting to be able to use the developments made in an already finished project.

Several means and systems are used to store the information, but EFACEC, Automação e Robótica does not have a structured knowledge management system. The systems work independently in each department and there is not any interconnection between them.

When analysing departmental practices, it is important to refer the routines of knowledge sharing in the IT Department. They have virtual Fora used to put all the information about the projects and this knowledge is accessible to everyone that works in that specific department.

> "We have Fora where we can put the information about the project we are working on, the problems found, the questions from the clients." (Group recall - Managers)

"Every routine, every code that we have already created or used can be found in our forum. When we find some problem we do a search in the Internet and easily find some kind of solution that can help us solve the problem and this new code is stored in our forum." Technician from the IT Department.

In the Mechanical Department they have specific software where the information is stored and it can be consulted but only by those who have access to the software.

The Innovation Project can be seen as an innovation interruption that played an important role in individual knowledge sharing and in the creation of new organisational knowledge. One of the workshops' goals was the revision of routines in order to create a new business model, including workers and Managers' relations.

The knowledge shared among workers and Managers is mainly technical knowledge. They have projects with a time frame defined and conditioned by the clients, and they focus themselves only in the technical project using the same organisational practices, even if these could be changed to improve the projects' efficiency.

> "The share of knowledge between Technicians and Managers are made through technical drawings." (Group recall - Managers)

"When we begin a project, technical drawings are the main documentation of the project. All the project's changes need to be reflected in the technical drawings in order to fulfil a good equipment or system's implementation." Manager from the Mechanical Department.

It is a fact that each department reuses the specific knowledge created and that is inherent to each project. However, Managers are not aware of the technology or other mechanisms used by other departments to facilitate de share of knowledge, specially the ones used in the IT Department.

b) Knowledge sharing and transference in the work field

Since the beginning of the Innovation Project, Managers from EFACEC Automação e Robótica have regular meetings every fifteen days that become an arena for co-ordination and knowledge sharing. However, only the Managers participate in these meetings.

Managers assumed that it would be important to have project team meetings whenever a project is finished. This was an important process of sharing and learning.

> "One of our idea is to implement the share of knowledge about all the finished projects through a meeting where the Project Manager presents the product developed, the processes used, the problems that occurred and the solutions applied. However, this is a very complicated process because most of the projects are developed in the clients' facilities and the Technicians are away several months a year.
>
> This implies that we see the projects' results but without any consistent learning." (Group recall - Managers)

"We won a big project in Austria and because the whole project was developed in the client's facilities, we only contacted our organisation when it was really necessary, spending several months on-site. When the project came to an end, we were transferred to another project without any time to make any kind of reflections." Manager from the Mechanical Department.

Another way of sharing is trough the project Managers' meetings where they share their knowledge to their colleagues based on their interpretations, perspectives and experiences. These meetings are seen not only as occasions for knowledge transfer, but mainly as instruments of control. They use it to plan the work in a very concrete way and to discuss which problems have to be solved.

However, these meetings would be a real arena of share and knowledge creation if they where extended to all project members, even if they have the constraint of workers that belong to team projects but are not present in the organisation (when working in the clients' facilities).

> "The main reason for this not happening is the project's time constraints, and the fact that the projects are developed abroad." (Group recall - Managers)

However, meetings could have different forms since it is not mandatory for them to be held in traditional prudential form. An important aspect of meetings as an arena for knowledge share and creation is that different perspectives, ideas, interpretations, roles, experiences and so forth come together. This means that meetings do not have to incorporate physically present individuals, but a meeting could be held with physical artefacts upon which these perspectives, ideas, interpretations and experiences could be represented and passed on from one individual to another, i.e. the drawing of a new product.

Another example of how such a meeting could take place is as a knowledge creation routine which could be able to carry around proposed technical solutions between

members of the project, and even let project members act upon them by giving advice or try to promote another idea.

In the meetings, whether people are physically present or not, a continuous creation and recreation of the shared target, the problems related to it and their consequences on the project context could take place. When people choose to act upon the information that is represented in the meeting, they take part in a growing organisational process.

c) Transforming tacit into explicit knowledge

In EFACEC, Automação e Robótica there is not any structured processes to transform implicit knowledge in explicit knowledge. The Managers are very aware of this:

> "Transforming implicit knowledge into explicit knowledge is an issue that we must improve in the short term. The Technicians develop new knowledge in every project they are involved in because the technological innovation is a specific value of our work, but this knowledge is not made explicit." (Group recall - Managers)

"When we have some doubts that can be solved by knowledge created in another project we just ask our colleagues. It's easier then having to try to find some information related to our problem." Technician from the Electrical Department.

This is an aspect that EFACEC, Automação e Robótica should work on because tacit knowledge is their most important competitive advantage to win big international projects, especially because the technological knowledge that they develop in automation and robotic systems isn't made available in a structured way. If the most qualified and experient workers leave, the organisation will face serious problems.

> "There are no structured processes to transform implicit knowledge into explicit knowledge. There is an idea to create the means to do it, but at this moment that still doesn't exist. In the IT Department, we have created a Forum where we store all the information regarding projects: helpdesk information, problems solved, innovations, routines, and so on. At this moment, only IT has this kind of means, but during the workshops there was a suggestion to create a global forum for the whole organisation." (Group recall 1- Technicians)

"I have made the suggestion, during innovation workshops, to create a global Forum for us to share the knowledge created in each department, but the idea was not implemented. Other ideas were found more urgent". Technician from IT Department

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The only expression of explicit knowledge is made in drawings and accountability sheets, but this is not made available to everyone in the organisation. Only the people that work in a specific project have access to that knowledge. If they begin another similar project but with different workers participating in it, the previous team's knowledge is not completely reused either because the people involved are not aware of its existence or because its access is made very difficult.

> "There should be a bigger share of knowledge not only in the same department but also between departments. For instance, the Mechanical Department and the Automation Department have a technical link in every project, but there isn't an effective share of knowledge between them since they work separately without analysing each other's work." (Group recall - Managers)

EFACEC, Automação e Robótica main ways of expressing explicit knowledge:

- Written: through e-mail, documents and discussion groups.

  For example: Manuals and documentation related to the projects.

- Visual: using models, illustrations or data visualization tools.

  For example: the new organisational structure is displayed in each room of the organisation, together with its mission and quality principles.

- Spoken word: voice mail or recordings, the telephone or person-to-person interaction.

  For example: Managers and project Managers' meetings.

- Video/ observation: video database, body language, master-apprentice relationship, videoconferences.

  For example: the forum and projects' documentation.

- Combination: technologies can be adopted so as to include some or all of the above.

Innovation Projects have promoted the communication and information process among Managers and Technicians. The information used to spread knowledge among workers is mainly technical and they do not have difficulties in understanding it. However, other kind of information – organisational information – began to be spread since the Innovation Project began.

> "We don't find it hard to understand all the information diffused by the Managers. Most of it is technical information related to our work. However, since the Innovation Project,

we have more information about the organisation's performance and other issues related to the organisation. This is a good thing that happened." (Group recall 1 - Technicians)

"Engineer Mário Clemente tells us about the organisation's performance not only in terms of financial results, but also in terms of the organisational climate. This helps us to know our organisation a little better, and to identify what we can do to help make it a better place to work in." Technician from the Automation Department

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Some of the developed and shared knowledge is documented and made available to everyone in the organisation, although it is mainly related to the specific work that is being developed in a given time.

Technicians referred that they didn't use the potentialities of their intranet, and did not search for the available knowledge (papers, articles, technical files, and other documents).

"We have a lot of information accessible in the intranet, but the Robotic area is not developed. I think there is someone working on it. My colleagues do not really use the intranet, only when they need to solve issues related to Human Resources Services like, for example, to justify absence. We do not have an intranet culture, although it has very interesting articles that we could use to develop our knowledge. We should create a space in the Bar where we could put some interesting articles to share with our colleagues." (Group recall 1 - Technicians)

"It's important to say that in the beginning of the intranet, our home page was the Innovation Office page, where we could always find some interesting information, but most of our colleagues have changed their home page to something else." Technician from the IT Department

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About the new knowledge created in the organisation, there is not a generalized concern in making it explicit to everyone. Sometimes the share of that knowledge is made in an informal way through informal conversation.

"We don't explicit the new knowledge, but everybody knows who has been involved in the development of new knowledge and, if needed, we can ask him/her for an

> explanation about it. At this moment, the Project Manager is gathering all the information in order to create a project database." (Group recall 1 - Technicians)

The creation of a project database could be the beginning and the basis of a knowledge management system, which could bring advantages to the organisation in terms of efficiency since it would give access to knowledge and make its reutilization possible.

Workers from EFACEC, Automação e Robótica share knowledge with their colleagues and Managers in a very restricted way. Only the workers of a specific department have access to that knowledge.

> "Some departments use specific software, where the structures of machines are being created (drawings, documents with technical specifications, budgets and costs). We store there the information and if anyone needs to search this information, they can do it. However, it is only available to people who work in that specific department. Sharing information between departments is not available for the entire organisation." (Group recall 1 - Technicians)

According to the share of knowledge between Technicians and Managers, they use project documentation only to share explicit knowledge.

> "The share of knowledge between the Technicians and the Managers is made through technical drawings." (Group recall - Managers)

5.3.4.3 2nd Dilemma

"The use and share of employees' individual knowledge is an important factor to solve problems and strengthen performance. However, several organisational and individual barriers condition the process."

> a) Mapping the most important knowledge and competencies for the organisation

Managers in EFACEC, Automação e Robótica are not aware of the workers' competencies. However, they can identify very clearly the competencies they do not have. To take part of the existing competencies and to invest in their development, Managers should make an effort to identify and nourish the competencies that can help the organisation become more competitive.

> "Competencies are not mapped. We only have product manuals. All the knowledge about competencies is informal." (Group Recall - Managers)

In fact, the expression of Manager's perceptions of workers' competencies create an important management instrument that could help them understand the organisation's strengths in terms of competencies, and identify areas where competencies need to be strengthened or developed.

However, the Performance Evaluation Process intended to identify the lack of workers' competencies.

> "We analyse the lack of competencies during the Performance Evaluation Process at the end of each year. We have an individual meeting with the workers and discuss all these issues. The lack of competencies is solved with training, mostly on-the-job training because workers have difficulties in attending training sessions: we never know when a project begins or when we have to develop some kind of crucial activity." (Group Recall -Managers)

"Every year we identify some training courses that we find important for our development, but we never know if it is possible to attend. It depends on the projects and on our daily activities." Technician from the Automation Department

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EFACEC, Automação e Robótica main process to develop individual competences and knowledge is on-the-job training processes.

> "Projects need a technical and technological research that implies a continuous process of creating and developing new competencies." (Group recall - Managers)

It is important to point out that Technicians' rotation between the teams is one of the most important ways of creating and sharing new knowledge in this organisation.

However, they have a training plan that is not accomplished because Technicians and Project Managers, especially in the Automation Department, are conditioned by the project's time constraints. They work almost all the time in the client's installations and they are also dependent on the suppliers that conditions the ongoing project and, consequently, the training plan.

> "We have an annual training plan and the training schedule is defined by the workers but it is impossible to accomplish this plan. It is very difficult to make it compatible with the workers' availability." (Group Recall - Managers)

Technicians point out some difficulties in attending the training courses because of the unpredictability of the projects and time and space constraints: they never know what is

going to happen each week because it depends on the ongoing project and the contingency plan that they have to accomplish to solve the project's problems.

> "We have an annual training plan, but the most Technicians can´t attend the training sessions because we have time and space constraints." (Group recall 1-Technicians)

Managers referred that the EFACEC week training plan does not have interesting training courses, which also conditions the training process.

> "Workers can suggest the training they want to have, since there are no interesting options in the EFACEC's training plan. Several years ago the training plan was more interesting and we even had leadership and teamwork training." (Group Recall - Managers)

b) Who are the carriers of valuable and scarce knowledge?

EFACEC, Automação e Robótica does not have an explicit way of making available the information about the workers who have the more valuable and scarce knowledge in the organisation. Only Project Managers have this information.

> "The Project Managers know who has the most valuable knowledge in EFACEC, Automação e Robótica." (Group Recall - Managers)

"Because project Managers work with us in very complex projects and with several constraints, they are the only ones who really know our capabilities and our weaknesses." Technician from the Automation Department

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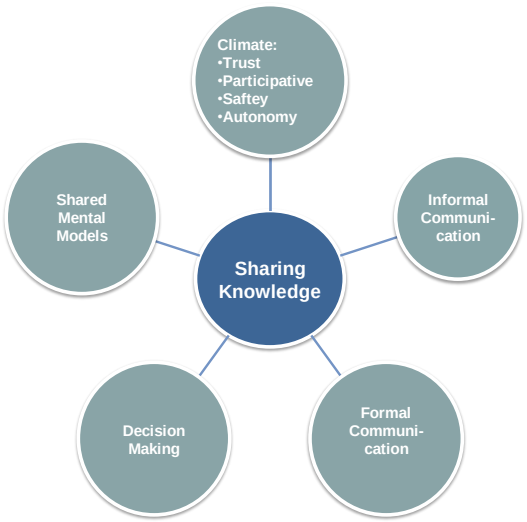
Nevertheless, they have a structured Performance Appraisal that should give information about the workers' performance, and implicitly about the ones that carry the most valuable knowledge, but it seems that they do not explore all the potentialities of this tool in terms of human resources management. This kind of information could help them be more efficient, allocating workers to the most adequate project or activity.

c) Using and sharing knowledge to help the organisation respond to challenges

To respond to complex international projects, EFACEC, Automação e Robótica workers combine informal relations among Technicians and project Managers, and more formal relationships among themselves and Managers and top management. Because they work in projects out of the organisation's physical boundaries, they have

levels of decision making according to their responsibilities range, but the decisions are participated within the project team where they share the same mental models essential to accomplishing their goals – finishing the project on time and according to quality standards. This kind of relationships and ties can be seen in the next figure that shows the different elements of knowledge sharing process in the organisation.

Figure 18 – Knowledge sharing in EFACEC Automação e Robótica



The nature and the complexity of their work imposes that they create an environment where trust assumes an important value. The success of a project has as structural basis the trust on each person's technical competencies, their participation in finding new solutions and ways to solve problems. Because they work on-site, their level of autonomy is crucial to assume some risks and take some decisions.

They do not have much formal communications. Most of the interactions between Technicians and Managers are informal, but even if there are not a lot of routines or formalities in the processes of knowledge sharing, each project team is effectively helping the organisation respond to its challenges and they are the basis to the creation of new knowledge.

> "The search for technical solutions in every project in which Technicians are involved is the most relevant process of developing new knowledge." (Group Recall - Managers)

Because Technicians spend a lot of time in the client's facilities, its important that the processes to promote sharing be introduced into everyday work activities, and technology should facilitate and enable the sharing across time and space.

d) Using knowledge in problem solving

Individual knowledge may be highly relevant in problem solving situations because Technicians are geographically dispersed and they need to make some decisions and solve some problems autonomously. According to EFACEC, Automação e Robótica, there are some compliance routines to help solve technical problems, but the organisational ones need to be solved by Managers.

> "The team solves the problems. It depends on the complexity of the problem and the money involved. Technical problems are treated as non-compliances. The organisational problems are solved by the Managers." (Group Recall - Managers)

"We have a quality system that helps us deal with technical problems. The manual has a set of phases that we have to accomplish to treat the non-compliances. But most part of our problems appear with new situations that we have to solve in a very short time, or it can compromise the established end of the project." Technician from the Mechanical Department

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The projects' own technical nature conditions the process of problem solving. If the problem is too complex, they try to solve it within the project team with the help of the head of the departments involved in that specific project.

> "It depends on the problem. Most technical problems are solved by the team and the project Manager. If it is a more complex problem, the Department Managers are involved and they try to find a solution together." (Group Recall - Managers)

It seems that they have quality routines for problem solving, especially when it comes to technical problems, and the more complex organisational problems are centralized in the Department Managers. They have space for informal sharing and development, especially for solving the problem before the client notices what is happening.

> "In the Mechanical Department we have implemented a new system of quality control and the problems and non-compliances are reported to the project Manager." (Group Recall 2 - Technicians)

On the other hand, when Technicians were discussing in the group recall sessions if they use their individual knowledge to help the organisation solve problems, they all answered positively.

> "It depends on the autonomy that is given to the worker. If it is a very complex problem or if it involves many expenses, the worker does not have autonomy and Managers have to be involved and decide what to do. On the other hand, if it is a team, the whole team tries to solve the problem." (Group recall 1 and 2- Technicians)

However, only the IT Department uses a structured tool to store the new knowledge that results from the solving a problem. Nonaka et al. (2000) argue that instead of merely solving problems, organisations should create and define problems, develop and apply new knowledge to solve other problems, and then again develop new knowledge through the action of problem solving.

> "In the IT Department we have meetings to discuss the ongoing projects and to solve the emergent problems. Every fifteen days we have a meeting with the Department Manager and EFACEC, Automação e Robótica General Manager to analyse the projects, discuss issues like project delays, financial issues and other technical aspects." (Group recall 1- Technicians)

Another aspect is the participants' role in problem solving situations. When there is a technical problem, they solve it internally and sometimes with the client's help.

> "In a general way, we solve technical problems internally and with the clients." (Group Recall 2 - Technicians)

When the complexity of the problem is not very high, the Technicians can solve it by themselves.

> "In some cases, the Technicians or the team find the solution and present it to the Manager." (Group Recall 2 - Technicians)

But if the problem is very complex, according to the Technicians, the solution becomes the Managers' responsibility.

> "Managers try to solve complex problems. However, we already have procedures that help to analyse and solve problems". (Group Recall 2 - Technicians)

The equipment suppliers also have an important role in problem solving situations:

> "When the problem is with the equipments, its solution depends on the supplier and in most cases that influences the time frame for the completion of the project, creating several delays." (Group Recall 2 - Technicians)

They only use external help when consultancy services are a part of the project or when the project is developed outside the organisation.

> "We only use external help if the project was adjudicated to an external company". (Group Recall 2 - Technicians)

Under the assumption that knowledge is created more or less automatically when solving problems, the question of how to transfer and share tacit knowledge becomes crucial.

e) Barriers associated to the introduction of new knowledge

In the beginning of the innovation project, some workers showed resistance to the change and didn't participate with the same enthusiasm as other co-workers, sharing their ideas and opinions in order to contribute to the new organisational strategy.

> "Some workers believed in the Innovation Project but others said that the project didn´t change a thing." (Group recall 2 - Technicians)

This could be explained through several factors like fear to be misunderstood and misinterpreted, or fear from the perceived value of knowledge made by the other Technicians and Managers.

"I think that we still have much to do in an organisational perspective. In general, we are not satisfied with the work relations, but we are a little better than before Eng. Mário Clemêncio. There is more openness to give our opinion and this is a good thing resulting from the Innovation Project." Technician from the Electrical Department

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People work in confined departments, they do not move around, and do not have the habit of sharing their ideas with their colleagues from other departments unless it is necessary for some kind of project, and mainly when it comes to technological problems. They do not have a culture of knowledge share and this is the main obstacle for EFACEC, Automação e Robótica.

f) Managers' role in promoting employees' participation in using new knowledge and sharing their own knowledge.

After the organisational Innovation Project began, new practices and management systems were implemented. To help Managers develop their competencies, there was

a training course on leadership intended to develop some coaching techniques, help reshape their relationship with the Technicians and help Technicians to adopt a more participative attitude.

> "We are very aware that the change of attitudes and behaviour is very complex and that we need time to make it real." (Group recall - Managers)

Technicians point out that every passing day they become less participative in the organisational changes, even having the notion that Managers are more open to their ideas.

> "After the Innovation Project, Managers assured us that the most efficient ideas would be implemented. Initially everyone was involved, but the everyday activities leave us with no time to think about the organisational changes." (Group recall 2 - Technicians)

It´s no doubt that all organisational actors use and share their technical knowledge because the nature of their jobs, but when it comes to organisational knowledge, Technicians need other kind of motivation to be more participative.

5.3.4.4 3rd Dilemma

"Using and sharing individual knowledge is crucial to organisational innovation processes, but organisational culture and management resistence make it very difficult to promote employee's involvement and participation."

a) Knowledge culture

Several elements can influence the creation and development of knowledge culture: the organisational structure, people, rewarding systems, leadership, business processes and information systems (Drucker, 1999; DeLong and Fahey, 2000; Gupta and Govindarajan, 2000; Wenger et al., 2002). Besides all these factors, several others can potentiate the creation of a knowledge culture, a learning environment and the knowledge sharing routines.

Beginning with the learning environment in the organisation, it is possible to categorize EFACEC, Automação e Robótica as a knowledge organisation with some characteristics that promote learning. One important factor is the incentive that Managers try to give to Technicians to develop their own competencies, specially their technical competencies because these are crucial for the organisation business.

> "EFACEC Robótica has a learning environment because of the nature of the business. Each and every project is technically different from each other." (Group Recall - Managers)

Technicians point out the organisation as a learning space:

> "There is a learning environment when it comes to technical issues, but not about organisational issues. The Innovation Project helps us to learn a lot about organisational processes and organisational changes." (Group recall 1 - Technicians)

> "There has always been a learning space. Each project is a challenge. We are the best." (Group recall 2 - Technicians)

Performance appraisal meetings are a special space where workers have the opportunity to identify their training needs.

> "In performance appraisal meetings the worker is motivated to reveal the training needs required for his professional development. On the other hand, all the workers participate in the definition of the training plan." (Group Recall - Managers)

However, they seam to have some difficulties in attending the training courses they identified as essential to develop their competencies:

> "Employees can suggest the training courses they want to have, but they have no saying in EFACEC's training program and it is very difficult to make it compatible with people's availability.
>
> Because of this, the training plan is not accomplished. This affects specially the Automation Department, because the Technicians spend their work time in the client's facilities and also because of their dependency on suppliers, which can condition the ongoing project and, consequently, the training plan. Training dates are defined by the workers but it is impossible to accomplish what was planned." (Group recall -Managers)

The meetings also allow the share of knowledge among the workers and their Managers:

> "The meetings are a space where they can share ideas and discuss issues about the organisation." (Group recall 1- Technicians)

It also helps to consolidate the new ways of communicating and working introduced by the Innovation Project. For instance, the teamwork that helped to implement the new project structure and strategy.

> "Teamwork has being improved since the Innovation Project was implemented with the new organisational structure and strategy." (Group Recall - Managers)

"At the beginning of the new structure implementation we had some problems. We had Department Managers and Project Managers and we did not know which one we had to report to. This created several problematic situations. Finally, Managers decided that we had to follow the priorities defined by Managers." Technician from the Automation Department

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b) Space for workers to analyse their work

Managers urge the employees to analyse their work, but there are some project constraints that prevent that: time is one of the biggest constraint:

> "We urge them to analyse the work, but we have several constraints of time and most of the times that becomes impossible. Maybe if we could do it in a more structured way, it would be a chance to learn with our errors and successes." (Group recall -Managers)

IT seems to be different, perhaps because of the nature of the work they develop.

> "Everyone with creativity and initiative is always innovating or changing the programming with the goal to make it more efficient. We have standard products which we adapt to projects, but most of the times we need to change them because of client's specificities." (Group recall 2 - Technicians)

It is also important for the organisation's competitive advantage that Technicians and Managers make a deep analysis of their work and develop more efficient products and processes. Although they have not implemented any routines of innovation, they are an innovative organisation with special value, constantly increasing its market share and competing with international organisations.

> "EFACEC's most important value in international contests is its custom-built solutions. Each project is different and even if sometimes we use part of a product developed in another project, most of it is very different. This makes us innovate all the time.
>
> Most of the electric mechanisms of a project are standard. The most significant change made by one of the Technicians was to develop a machine with one signal tool instead of too". (Group recall 2-Technicians)

To promote participation, top Managers understand the need to ensure open channels of communication and a culture that encourages people to be proactive.

Following this strategy, some departments have been introducing several new practices that can help them develop their work as project's members, like the Fora where they store all the information related to the projects, so it can be searched and reused easily.

> "Some of the new practices introduced in the department don't have visibility in the organisation. However, they are important for the department. For instance, the creation of the Fora in the IT Department, where we store the problems and the solutions, was an important innovation. In the EFACEC Group, the introduction of new practices were referred to in the organisation's newsletter (EF@NEWS)". (Group recall 1-Technicians)

The projects' different characteristics, together with the different organisations and countries where they are developed, make each one unique. This makes it difficult for people to create and follow work routines or even knowledge sharing routines.

> "We don't have any routines because every project is different from the other. With the Innovation Project we have began to create some routines, like the meetings where we can discuss the problems and the organisation itself." (Group recall 1-Technicians)

But the share is made, most of the times, in a random way. Because this is a medium organisation, they can manage it and accomplish their primary goal: to be innovative.

> "In the IT Department a problem in one project can leave to a change in all procedures. For instance, an algorithm may have to be changed because it has to adapt to the client's needs. This may be done by the worker's own initiative or because the change was discussed in a meeting and the Manager agreed with the change." (Group recall 2 - Technicians)

"We have autonomy to change our technical procedures. They just have to work and solve the problem in the minimum time possible so as not to affect the project conclusion." Technician from IT Department

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Managers participate differently in the analysis of the work practices and procedures. The IT Department Manager has sometimes difficulties when analysing the work together with the Technicians.

> "In the IT Department, the Manager has very little time to make any kind of analysis. We are pressured by the time frame and any analysis is often made by the workers in

> the ongoing project. We don't have time to adjust our activities." (Group recall 1 - Technicians)

But the Mechanical Department Manager assumes a coaching behaviour and analyses the work, interfering and helping to make them work better and more efficiently.

> "In the Mechanical Department we analyse the work together with the Manager. He always says 'This is wrong, what can we do to make it better?'" (Group recall 1 - Technicians)

According to the projects' quality analysis, its, results and the ongoing process, they have implemented some quality procedures that also include the clients and all the project's participants. With this procedure, they try to verify the clients' level of satisfaction, and give some feedback to the Project Manager and to the project's team.

> "We have the will to do that, but we don't have the time. The work results are the practical applicability. The client analyses the quality of the work and criticizes all the things that don't work well. We have a quality sheet which is sent to the client so he can give his opinion about the project's quality, and sometimes this sheet is sent to all project's participants." (Group recall 2 - Technicians)

c) Managers' role

In terms of human resources management, the new practices introduced after the Innovation Project can be used to encourage the sharing of knowledge. These include HR management policies, like the reward system, the new incentives related to the team's working results, the performance appraisal, and competencies development through training.

> "With the new reward system linking to the Balanced Score Card, all the employees are responsible for the organisation's performance and for the team's evaluation. The implementation of this system is going to be tested by the end of the year (2006) when the annual reward will be distributed by the teams. We already had one test but the reward was similar for everyone, with no performance distinction. But it was a good thing because it helped the workers to be aware of the importance of their responsibility in the teams' performance." (Group Recall - Managers)

> "We noticed that some workers are very concerned with the fact that if someone in the team got a bad performance it could affect all the team members. So, they help each other to overcome the obstacles and the problems that occur." (Group Recall - Managers)

"We are expectant to the BSC and the annual rewards, because last year it didn't work very well. We shall see if this year we do not feel that some people's rewards were not based on their performance. This is one of the main issues that had a negative reflection in the environment questionnaire." Technician from IT Department

Both Managers and Technicians have the same perception about the projects developed and all the activities related to each project. Since there is not a final meeting for each project, sometimes the Technicians do not have any feedback about their work, only a handful of Managers give this kind of feedback.

> "In the Mechanical Department, when everything is alright with the project, the Manager reports it to the Technicians. But this doesn't happen in the other departments. This is not a general practice and it needs to be improved." (Group recall 2 - Technicians)

However, in the group recall sessions Managers assumed the need to implement this type of mechanism to share the knowledge produced during the project and to closely identify good practices and practices that should be improved.

> "We intended to do a final meeting at the end of each project with all the participants in order to acknowledge what went wrong, what could have gone better, the new developments in each area, but we never did it." (Group recall - Managers)

"We tried to schedule some meetings to discuss the issues related to the projects' closing procedures, but it didn't seam to be possible because each one of us seems to have always crucial activities to accomplish." Manager from the Mechanical Department

Technicians also point out that some Managers are away for long periods and that they do not have any feedback about the ongoing projects.

> "Some Managers are away for long periods of time, so there is no feedback during the ongoing project. We had the idea of doing a meeting at the end of the project but that has yet to be implemented." (Group recall 2 - Technicians)

The only feedback that some workers have is through the Performance Appraisal meetings at the end of the year.

> "The feedback is given in the Performance Appraisal at the end of the year, but we are aware that it should be done more often." (Group Recall - Managers)

It would also be important to develop other HR practices like job descriptions, revised competencies, a rotation policy, succession planning, and most importantly training and learning opportunities.

Another important aspect is the balance between employee's personal ambition and the organisation's own development plan.

> "We try to create that kind of balance, but it is not always possible since the EFACEC Group has rules that we have to follow. Also, today's job market doesn't allow us to develop ourselves and this situation constrains the employees' promotion and the rewards system." (Group Recall - Managers)

Despite Managers' opinion, Technicians are highly motivated and identify their own goals with the organisation's goals.

> "At this moment, our goals are similar to the organisation's goals. We always have another challenge." (Group recall 2 - Technicians)

The balance between work and family is also a crucial issue at EFACEC, Automação e Robótica because most projects are international and the workers spend long periods away from their families.

> "The organisation doesn't have into account the employees' family life. Since they spend a lot of time out of the organisation, in the clients' installations, this causes dissatisfaction and reduces productivity". (Group recall 1 - Technicians)

d) Responsibility for the organisation's performance

The Organisational Innovation Project brings a major identification of the workers with the organisation because they have participated in the new strategy definition and in the new organisational structure design, although some of the group recall participants referred that the final organisational structure doesn't seam not to be the same that they have defined.

> "Since the Innovation Project, in which we have participated effectively, we feel a stronger identification with the organisation. The only thing that we don´t agree with is the new organisational structure. This structure is different from the one that we all have defined during the workshops." (Group recall 1 -Technicians)

> "The organisational structure changed from hierarchic to matrical and several people work for several projects. They have one vertical manager and two horizontal managers." (Group recall 2 - Technicians)

This new organisational structure also brings some difficulties about the management and reporting processes because there are functional Managers and mroject Managers and workers have to report to all of them at the same time.

> "With this new structure the work organisation seems to be very confusing sometimes because each worker has 3 or 4 Managers and needs to report to all of them at the same time each day. Managers have meetings where they organise and plan all the activities, but the Technicians sometimes feel very confused." (Group recall 2 - Technicians)

To overcome this situation Managers have defined that functional managers set the priorities and then they negotiate with the Project Managers the workers' allocation for each project and specific activities.

> "In the Electrical Department the situation is better now: one person can work for several speciality Managers, but the vertical manager defines the priorities, and this was not happening before this change." (Group recall 2 - Technicians)

> "If the speciality Manager and the Project Manager have a problem, they consult the vertical manager. This is now a new procedure. Before this new structure the subject matter expert used to put all the pressure in the worker and he/she had to be responsible for developing all the activities." (Group recall 2 - Technicians)

This new structure also brings several positive results in terms of project management, especially in the control process, helping to reduce projects' delays.

> "Before this new structure the situation was a lot worst. Now we are more aware of projects' delays because the control processes works better." (Group recall 1 - Technicians)

All Technicians seam to have the same perception about the improvement in terms of project planning and controlling.

> "At a control level, things are better. Now we have an efficient planning and we can see the priorities and the ongoing projects." (Group recall 2 - Technicians)

Another facilitator for knowledge sharing deriving from the Organisational Innovation Project was the need to implement periodic meetings to discuss all the problems and

situations related to the projects. However, this procedure is not similar in every department, but they intent to extend it to the whole organisation in the near future.

> "In some departments we have meetings every 15 days so we can discuss all the projects' problems. In the Electric Department, there are no meetings because the Manager is always at the client's facilities. All the questions are discussed by phone. It's very rare for meetings to take place." (Group recall 2 - Technicians)

In the Technicians' perception, Managers and co-workers behave themselves as performance controllers and this kind of situation make every one more aware of their responsibility for the organisation's performance.

> "Co-workers control each other because they are all responsible for the team's performance.
>
> Our performance influences variable rewards. If the organisation has a good performance and good results at the end of the year, the workers are rewarded. The GDD – Gestão do Desempenho e Desenvolvimento (Performance Appraisal) evaluates each team's performance, but all the employees have a meeting with the Manager about their specific performance." (Group recall 2 - Technicians)

Since 2005 EFACEC, Automação e Robótica has introduced variable rewards in the employees' reward system, and this has increased the workers' motivation. The new system has also increased their perception of fairness because it is linked to the BSC (Balanced Scorecard) indicators, with a very objective nature.

> "Last December (2005) all the employees received a bonus. In the past the criteria was not clear and only some people received the bonus. Mow this has changed. The balanced scorecard makes things more clear because the criteria are explicit for everyone." (Group recall 2 - Technicians)

However, variable rewards are conditioned by each project's proposal and the negotiable capability of EFACEC, Automação e Robótica in a very competitive market. It also depends on their capacity to finish the projects on time and in the defined costs. This sometimes creates a sense of unfairness, because there are several factors that cannot be controlled, especially some technical problems that depend on the suppliers.

> "But not all is fair because we are conditioned by the financial and commercial proposal. If the final cost is below the budget, the reward is calculated taking that in account. So, we are dependent on the accuracy of the proposal and on the project's deadline (if the project doesn't suffer huge delays because of technical problems or

> any other factors like the suppliers' bad planning). This makes the system unfair." (Group recall 2 - Technicians)

Another aspect is the fact that performance evaluation meetings are only held once at the end of the year.

> "In the GDD meeting we have some feedback, but because this occurs once at the end of the year, sometimes the Manager only remembers the last projects, and if one of them went wrong, this is the last impression and that influences the Manager's evaluation.
>
> We suggested that the evaluating meetings should occur at the end of each project so that we can correct our errors and learn from them. Then the system of evaluation would be fairer." (Group recall 2 - Technicians)

Technicians point out that their last performance is the one under discussion in those annual meetings and if they did a great job in the first project, and if the results were not so good in the last project, then they would be penalised.

> "Last year I felt that my performance evaluation was not fair. I analysed the year's work and I was rewarded for it, but I think it was not enough. This year I'm trying to be more aware of my co-workers performance so I can compare myself to them." (Group recall 1-Technicians)

But this system is recognised to be much better than the previous one. The Innovation Project also contributed to an open communication and recognition from the Managers.

> "However, something has changed for the better. Now our Manager say 'Thank you' and, this makes us feel good and proud to work in this organisation." (Group recall 1 - Technicians)

All the changes and innovations implemented had one primary goal: to make the organisation profitable and provide it with a future strategy of being the best place to work in. This goal has been set to be accomplished in the next 5 years. According to Technicians, this is a very ambitious goal that will affect their performance appraisal and consequently the variable rewards.

> "The Innovation Project is going to be implemented in the next 5 years and the main goal is to reduce the deviations. But the goals of every team are to be accomplished in a short term. We should have the same time to accomplish our goals because they are very ambitious. This will have reflections on the Performance Appraisal and in the annual rewards." (Group recall 1-Technicians)

Another way of making the workers responsible for their performance was to give them a wider level of decision.

> "We can make some decisions, at our level, but I would like to be part of all the decisions that are made in my department. However, in some issues we don't have the knowledge to decide because we are 'the smallest part of the organisation' and we don't have the global vision of the project." (Group recall 1 - Technicians)

One procedure that Managers implemented to increase workers' motivation and identification to the organisation was to the "worker of the month".

> "We want to implement the worker of the month, but we have doubts about the criteria to select the best performance or the best idea." (Group recall - Managers)

However, according to the characteristics of the work, it seems not to be an easy process to define and implement. The researcher suggested rewarding the better project team, but it seems to be a difficult process because projects do not have well defined teams and the projects' duration is normally very long.

5.3.4.5 4th Dilemma

"Organisations need to promote individual knowledge sharing among all organisational actors, but organisations don't see the need to create mechanisms to promote this sharing."

Knowledge sharing is about transferring the dispersed know-how. It is, in fact, the systematic and continuous capture of knowledge built from years of experience inside and outside organisational boundaries so that others can perform immediately.

In EFACEC I found two major organisational routines of knowledge transfer: within-projects, tacit knowledge transfer and post-project, explicit knowledge transfer.

In the first one, the knowledge is transferred by the rotation of workers within projects. The teams change according to the project in course, the competencies needed and the existing human resources.

However, the tacitness of project development related knowledge makes it particularly difficult to transfer (Deyer & Nobeoka, 2000; Lynn, 1998). This has two major impacts: first of all tacit knowledge is embedded in an individual's experience, in ideals, values and emotions (Nonaka & Takeuchi, 1995), and secondly, it can only develop in a professional context through the "art of the practice" (Schön, 1983), i.e. by performing

the specific task(s). This would require some system or mechanisms for sharing tasks and responsibilities, i.e. job rotation practices.

In the latter, all project documentation is stored and, if necessary, made accessible, i.e. when another project begins and it becomes interesting to use developments made in an already finished project.

Several means and systems can be used to store information, but EFACEC does not have a structured knowledge management system. The systems work independently in each department and there are not any interconnectivity between them.

The main mechanisms that enable the knowledge share are the following:

a) Developing new ideas

Efacec, Automação e Robótica does not have an active program for developing new ideas. However, they have a suggestion box near the electronic system that controls the workers' schedule.

> "Efacec, Automação e Robótica has a suggestion box that has never been used." (Group recall - Managers)

"I didn't know we had a suggestion box. Where is it?" Technician from the IT Department

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During the group recall sessions, some of the Technicians said that they did not know that they had a suggestion box. But this is not the only mechanism that EFACEC, Automação e Robótica has for this kind of activity: the Innovation Office has also, in the intranet, a space for new ideas and suggestions.

However, this mechanism is not used as it should be. In the beginning, all workers who accessed the intranet had as Home Page the Innovation Office page, but most of them have changed it and know they don't even know if the Innovation Office has created new events or other functionalities because they don't visit their intranet page. Only one of IT Department Technicians new what were the new activities presented in the Innovation Office intranet Page because she consults it regularly.

> "The Innovation website gives us the possibility to expose our ideas and they will be analyzed by the Innovation Office and all have an answer. But there are few employees

> who know about it. One of the explanations is because we are free to change our home page and most employees have done it and stopped accessing the Innovation Office site." (Group recall 1-Technicians)

"Perhaps if the Innovation Office sent us some information every week about the events or introduced some kind of challenge, we would be more participative." Technician from the Automation Department

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Managers are also convicted that people do not contribute with new ideas because they are afraid of negative reaction. Managers assumed that:

> "A new idea is the one that causes or could cause changes to the organisation." (Group recall - Managers)

One of the explanations about the failure in the process of stimulating new ideas is the fact that the company does not have a reward system, and also the worker's perception that their ideas will be used effectively.

Technicians showed some reserves about the fact that the Managers could see their ideas as not strategically important and that this could conditioned the use of adequate resources to develop and implement them.

Because of this, most workers do not have entrepreneur behaviour. Technicians are always waiting for Managers to implement new organisational practices and processes or to change the existing ones. Even after the Innovation Project and the workshops, where all employees had participated with new ideas, they still settled after a while and nothing new has been suggested to improve the working practices.

One of the members of the group recall 1 referred that being an entrepreneur is not seen with "good eyes", because it bothers many people within the organisation.

This seems to work differently when they need to develop new technical ideas because they are the primary basis of their work.

> "In the technical field we gave several suggestions and new ideas and most of them were introduced in the current project. But at organisational level, we are very passive. Only during the Innovation Project, especially in the workshops, did all the employees give several ideas to improve our future." (Group recall 2 - Technicians)

Managers assume the importance given to the technical dimension of innovation and to the process of sharing ideas.

> "New technical ideas are exposed to the Managers and if they are viable we implement them." (Group Recall - Managers)

Managers are aware of their important supportive role when it comes to new ideas meant to promote the development of this crucial system of sharing individual knowledge:

> "We know we must have a supportive role when some idea is presented by the Technicians. Only this kind of behaviour helps create a more innovative culture, which doesn't exist yet." (Group Recall - Managers)

Technicians' perceptions about the possibility of sharing their ideas and that they could be accepted and implemented only exists since the Innovation Project.

> "We don't make any suggestions or give any ideas about the organisation. It was only in the Innovation Project that we felt we could explain our ideas and make suggestions.
>
> The Innovation Office is a unit from the EFACEC Group and they study every suggestion and give a positive or negative answer about it. However, this system was only adopted two years ago and most workers do not know it or use it.
>
> For instance, one of our suggestions was the creation of a nursery school that had a negative response because it was not financially viable. Other suggestion was an organisational environmental survey that was accepted and implemented." (Group Recall 1 - Technicians)

Management accepted the application of the survey to make explicit the workers' dissatisfaction about some issues that everyone was already aware. But the survey was seen as a beginning phase, a control variable. The implementation of the new management practices that resulted from the Innovation Project gave them hope to improve their life in the organisation and to improve the organisation's performance.

> "This survey was made after the Innovation Project and the results were not very good. But since the beginning of the survey application we all knew that the results probably would not be very good. People continue unsatisfied with several aspects of the daily life of the organisation, especially with aspects that involve their relationship with Managers and the rewards of their work. However, aspects related to job satisfaction or proudness of the organisation had very good results.

> In the next survey, after the implementation of the new structure, the management by goals and the new reward system, we hope that the results will be better." (Group recall 1- Technicians)

b) Workshops

The Innovation Project played an important role in individual knowledge sharing and in the creation of new organisational knowledge. The main goal of the workshops was the revision of routines in order to create a new business model based in a new relationship among Technicians and Managers.

Technician's perceptions about the workshops are that they were a way to make their opinions heard.

> "The Innovation Project was a way to listen to employees' ideas and opinions. It made us feel a part of the organisation and involved." (Group recall 2 - Technicians)

Manager's think that the workshops were a space to express everyone's ideas and for people to participate in the innovation process.

> "Workshops helped us see the new changes that were important to implement. All of the workers participated with ideas and opinions. It was an important moment for the organisation's future." (Group recall - Manages)

"I think that we should do a workshop like that once a year. It would probably increment our participation in the organisational issues." Technician from the Electrical Department

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c) Knowledge networks

EFACEC, Automação e Robótica could use its accumulated technical knowledge generated in all international projects in order to become a knowledge-based organisation, thus increasing the use and share of knowledge.

A knowledge network focused on sharing critical knowledge, on sharing practices, and functioning as a living repository of knowledge about the projects could potentialize all the accumulated knowledge they possess.

However, EFACEC, Automação e Robótica does not have a knowledge network and it seems that Managers do not see the importance and the potentialities of this mechanism to share and to help create new knowledge.

> "We don't have a knowledge network. This is a system of sharing knowledge important for EFACEC Group." (Group recall - Managers)

"EFACEC, Automação e Robótica has few workers. We have not felt the need for a knowledge network. Perhaps in the future we can participate in the Group network." Manager from the Production Department

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Technicians do see the value of a knowledge network as an instrument for continuously learning, a new way to quickly connect with colleagues in order to access and benefit from an organisational memory, as well as externally generated knowledge. This could help them become more effective and learn from each other's experience.

> "We only use the intranet. But there are no contacts between EFACEC's Business Units. Co-workers from different business units do not share information or knowledge among themselves." (Group recall 1- Technicians)

> "We sometimes share opinions in informal conversations in sporadic training sessions where the participants belong to different Business Units." (Group recall 1-Technicians)

Presently, EFACEC, Automação e Robótica has few instruments that enable the share: annual reports and project documentation are among these. But these documents need to be organised and stored so they can be reused. Many of the reports generated by workers are currently underused as vehicles for sharing relevant experiences, and seen as little more than formal requirements. Therefore, such instruments are not necessarily compiled in order to urge the sharing of knowledge.

When analysing specific practices in the departments, it is important to refer the IT departmental routines to share knowledge.

> "We have Fora where we can put the information about the project we are working on. The problems found and the questions from the clients." (Group recall 1-Technicians)

It is important to refer that Managers weren't aware of the mechanisms used by the IT Department to share the knowledge inherent to each project.

The Mechanical Department uses specific software where the information is stored and it can be searched, but it can only be used by those who have access to that software.

> "There should be an increment in the sharing of knowledge, not only in the same department but also between departments. For instance, the Mechanical Department and the Automation Department have a technical link in every project, but even so there isn't a lot of information shared between them, since they work independently without analysing each other's work." (Group recall - Managers)

When we focus on external networks, Technicians said that issue should be discussed with Managers and the Managers assumed that they have few contacts to the external actors of the organisation.

> "We don't have information about any contacts with other organisations. In the past we had a few projects where we developed a product with the help of an University. Perhaps Managers can answerer better to this question." (Group recall 1 – Technicians)

Managers have discussed this question in their group recall, and the external contacts referred were mainly with Universities for technology development.

> "We have contacted Universities when we need to develop some kind of technology but we don't have the internal competencies. We also have contacts with consultancies when they represent a client and not because EFACEC has a specific need." (Group recall - Managers)

5.3.4.6 5th Dilemma

"Knowledge is recognised by researchers and practitioners as a fundamental asset to the organisation's survival. However, organisations don't integrate and effectively use new knowledge created or developed by employees."

a) Integration of new knowledge and its effective use in everyday work

EFACEC, Automação e Robótica undertakes projects and activities in various countries under somewhat differing environments, time frames and under varying circumstances. This context is propitious to potentiate the learning process from theirs experiences and if they could make this knowledge available for subsequent activities, eliminating repetitious mistakes, they could reuse the knowledge created in other projects.

According to knowledge acquired through training courses or self-training processes, Managers point out that they always put it to practice.

> "The leadership training during the Innovation Project was very important to help in the change process." (Group recall - Managers)

Technicians referred the importance of self-training:

> "We use all knowledge that we developed during the projects, mostly by self-training and teamwork. In IT if we have to create a new routine or algorithm we have to study the programming language and the logical aspects of the routine." (Group recall 1-Technicians)

"Most of our competencies development is made through auto development, because we don´t have the time to develop them outside the organisation." Technician from the IT Department

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However, it is important to point out that they have very few formal training, even if the organisation and the nature of the projects imposes a continuous learning process.

> "Formal training is very difficult to attend, even the planed ones, because we spend a lot of time outside the organisation. We invest a lot of time in auto-training in technical issues because every project has some kind of innovation and we need to solve the technical problems that occur." (Group recall 1-Technicians)

The Technicians from the Mechanical Department use their individual technical knowledge developed in another working experience to integrate it into new projects and to create new knowledge.

> "All the knowledge about technical drawing, structures and machines is applied here in EFACEC, Automação e Robótica. So, I am using it and developing new knowledge. I'm always learning here at EFACEC." (Group recall 1- Technicians)

b) Incorporation of new knowledge into new products, services and processes

EFACEC, Automação e Robótica develops complex projects creating new knowledge in the process and when possible integrating the knowledge developed in the previous projects.

> "When we develop a product there are some technologies that are developed that will be used in another product. Sometimes we search for some technical specificity that is over-dimension but we know that it will be used in other projects." (Group recall - Managers)

However, they develop a lot of new technical knowledge because the projects are all innovations, but they do not innovate spontaneously. The innovation process is promoted by the clients' demands.

> "We only use the knowledge when we need it. We have R&D, but only because it's demanded by the clients. We do not have an I&D Department where people dedicate

themselves to creating some kind of innovation. All innovation that are made here are already paid by the clients." (Group recall 1- Technicians)

Different types of knowledge emerge during a project development from different organisational actors. Next figure represents the types of knowledge developed during a project:

Table 11 – Types of Project Knowledge in EFACEC, Automação e Robótica

Project Stage	Organisational Actors	Knowledge Type
Defining Product's Requirements	• Managers • Clients	• Requirements • Technical specifications • Quality values • Cost values
Design	• Mechanical Department • IT Department • Electrical Department	• Definition of the product required • Design values that influence initial requirements • Clients' suggestions • Requirements' priorities
Development	• Mechanical Department • IT Department • Electrical Department	• Development management and product's priorities • Designed deviations from design. • Client's feedback
Testing	• Mechanical Department • IT Department • Electrical Department	• Determination of tests and success criteria • Testing feedback from clients
Delivery	• Mechanical Department • IT Department • Electrical Department	• Description of product/system • Project reports

The knowledge sharing process remains a critical learning process, but when project teams split, some of their knowledge is lost. Each Technician and Manager have a partial appropriation of this knowledge, but because they don't have any knowledge management system, it is not efficiently reused in new projects and use for new knowledge creation. However, all project teams intensively generate new knowledge and then learn from each project they participate in, accumulating experiences and nuclear knowledge as a competitive advantage of the organisation.

Because of project time constraints, teams are unable to collaborate freely in exploring all alternatives and innovative design approaches. The schedule set demands attenuate knowledge integration, as an aggressive deadline restricts the freedom to learn.

Most of the share and integration of each project's specific knowledge among the project team members emerges through the documentation and from informal interactions during project's design and development.

c) Implementing practices from other organisations

> "It is necessary that the organisation knows other organisational practices. However, we do not know these practices. Several years ago some organisations made presentations of their practices, but not any more." (Group Recall - Managers)

Technicians considered that the methodology used during the workshops is a good practice developed by other organisations and implemented in EFACEC, Automação e Robótica.

> "The workshops held during the first phase of the Innovation Project were developed by an USA consultancy company, and we have used it." (Group recall 1-Technicians)

When analysing if people used knowledge developed in other working experiences in other organisations, most of the group recall participants referred that they used technical knowledge from other professional experiences but not organisational knowledge. Managers explained this fact: organisations are so different that it was not possible to use that kind of practices at EFACEC, Automação e Robótica.

> "Some of us had experiences in multinational organisations and because the culture is so different we could not use that organisational knowledge. There are some practices that I used in my former company, but I cannot use them here because there is a big cultural difference. This is a Portuguese SME and the other company was a multinational, so most of organisational practices can't be transferred". (Group Recall - Managers)

5.3.5 EFACEC Automação e Robótica Research Box

5.3.5.1 Knowledge Sharing Culture

The Innovation Project was the kickoff for a new phase in EFACEC, Automação e Robótica. The organisation needed to carry out a change process, defining what kind of organisational innovation could help it become more competitive in the future. The Innovation Project was the motor of that change.

It was then necessary to create a new culture, to make workers more participative and involved, and to implement a new structure based on project management - the first

structural change that could influenced the communication process, teamwork, the learning process, and mainly the process of individual knowledge sharing in EFACEC, Automação e Robótica.

The two major organisational routines of knowledge sharing deriving from the new project organisational structure was knowledge sharing within-projects (individual knowledge/tacit knowledge) and post-project knowledge sharing (explicit knowledge).

The Technicians' rotation within projects and the new teamwork practices helped to create the needed environment for Technicians to share their own knowledge, and when a project ends all documentation is stored and if necessary made accessible. Although EFACEC, Automação e Robótica has several means and systems to store that information, they do not have a structured knowledge management system.

This fact makes it difficult to manage the knowledge created in each project and its search and reuse, especially because EFACEC, Automação e Robótica undertakes projects in various countries.

On the other hand, the emerging knowledge sharing culture at EFACEC, Automação e Robótica facilitates the learning, especially through project teamwork and also through the meetings among Technicians and their Managers.

They learn from their experiences and even if they do not have mechanisms to make the knowledge available and easily reusable for the organisation as a whole, in each department they have created they own instruments to facilitate the knowledge storage, reuse and later development. However, because there is not any global mechanism of knowledge storage, when project team members split, some of this knowledge is lost.

To overcome this situation and to potentialize the knowledge they create and share, some departments have been introducing several new practices that could help them develop their work as members of the projects like the Fora where they store all the information related to the projects so it can be easily searched and reused.

Top Managers also became more aware of the need to ensure open channels of communication, creating project Managers and Managers' meetings every 15 days. Although Managers' feedback about the projects developed is not yet enough, they intent to create a meeting of the closing projects with the Technicians because

sometimes they do not have any feedback about their work. The only feedback routine practice is through the Performance Appraisal meetings at the end of the year.

In terms of human resources management, the new practices introduced after the Innovation Project can be used to encourage the sharing of knowledge. These include HR management policies like the reward system, the new incentives related to the results obtained by teams in projects, and the performance appraisal.

However, it could also be important to develop other HR practices like job descriptions, revised competencies, a rotation policy and succession planning, and, more importantly, well developed training and learning opportunities.

Finally, it is possible to affirm that a key factor in ensuring that a knowledge sharing culture is successfully implemented is the perception that there are advantages for everyone involved. A clear understanding of the meaning and implications of sharing, as well as proper motivation mechanisms are, therefore, essential components of any knowledge sharing strategy.

In this context, sharing needs to be recognized and rewarded at the individual level, as well as at the team level. This implies that workers will become more willing to share knowledge, especially with a system that can enable them to share.

EFACEC, Automação e Robótica knowledge sharing culture has had a huge impulse with the Organisational Innovation Project. Workers actively participated in sharing their ideas and opinions about the future of the organisation for the first time.

Nevertheless, presently, EFACEC, Automação e Robótica has few instruments that enable the share: annual reports and project documentation are among these. But these documents need to be organised and stored so they can be reused. Many of the reports generated by workers are currently underused as vehicles for sharing relevant experiences, and seen as little more than formal requirements. Therefore, such instruments are not necessarily compiled in order to urge the sharing of knowledge.

A knowledge network could be an instrument for continuously learning and an instrument that could facilitate the use of their accumulated technical knowledge developed in all international projects. This would help EFACEC, Automação e Robótica increase the use and share of knowledge, and to become a knowledge-based organisation.

5.3.5.2 Impacts of Individual Knowledge on Organisational Dimensions

Individual (tacit) knowledge exists randomly in organisations, and is made visible through its application and can, then be used in the innovation and change process. It is activated by generating new knowledge, by incorporating new knowledge in the design of a new product, when learning new practices and methods, when improving existing technology through improvements based on learning-by-doing. Also, learning through work increases the knowledge share and problem solving capability.

There seems to be little impact of individual knowledge sharing in organisational routines in EFACEC, Automação e Robótica. The organisation is not questioning its existing ways of doing things and proposing changes in operational processes in order to improve operational efficiency.

A survey of the impacts was also conducted as a specific request from the Innovation Office. Analysing the data we can identify different perceptions of the impacts, according to the hierarchical level:

a) Human resources practices

Reward Systems	100%
Practices of information transmission	100%
Workers' competencies	87,5%
Recruitment of new workers	87,5%
Performance Levels	75%
Motivation levels	75%
Managers' competencies	62,5%

All of the participants have answered that the new *reward system* implemented motivated the Technicians for teamwork and to share their technical knowledge with their co-workers and project Managers.

All have also answered that they have changed the *Practices of information transmission*, in terms of sharing ideas in the meetings and through all the information displayed in the organisation - the new organisational chart, the new mission and goals, the new strategy, and also the technical information that circulates in files.

Almost all participants (87,5%) have the opinion that the sharing process during the Innovation Project had helped develop W*orkers' competencies*,, specially when learning trough the work processes.

In the opinion of 87,5% of the participants, the knowledge sharing process and the changes in the organisation helped the organisation win several international projects and become more profitable, which created the need for the *Recruitment of new workers*.

On the other hand, 75% of the participants answered that the *Performance levels* had increased because of the new work practices like teamwork, and because of the new organisational structure that facilitated the development of the work, especially after the initial confusion about the functional role of Managers and project Managers. The *Performance levels* also contributed to the planning and controlling of projects, and to the reduction of project delays and cost deviations.

In addition, 75% have answered that *Motivation levels* had increased with the new emerging culture of participation and knowledge sharing.

Only 62,5% of the participants considerer that *Manager's competencies* have been developed in terms of leadership and in the ability to manage Technician's competencies through the definition of project teams and in the establishment of open and participative communication processes. But when analysing the questionnaires separately, we can find that most participants that answered that there had been a development in Managers' competencies were, in fact, Managers. Only 25% of Technicians agreed with that development.

b) Training

Major adequacy of training to organisational needs	100%
Specific technical training	100%
Participation in the diagnostic of training needs	75%
Behaviour training	50%
Innovation training	25%

All participants have answered that there was a *Major adequacy of training to organisational needs*, especially because of the leadership training after the beginning

of the Innovation Project and time management training to help implement the new project management practices.

All participants have answered that the knowledge sharing process helped identify the Mechanical Department's need for *Technical training* about new software essential for drawing designs.

Only 75% of the participants have pointed out their Participation *in the diagnostic of training needs*, identifying their own specific needs for competencies' development. The remaining participants (25%) that did not respond to that item were Technicians.

Although *Behaviour training* was referred by 50% of the participants, there is no evidence of any training in this kind of issue. Perhaps they have made an association with time management training. The same can be applied to *Training in innovation* referred by 25% of the respondents (all of them Technicians).

c) Work organisation

Total Quality Management Programs	87,5%
Project teams	75%
New work processes	62,5%
Networking	62,5%
Self Quality Control	50%
Increasing planning processes	37,5%
Increasing dialogue	37,5%
Semi-autonomous teams	25%
Services' externalization	12,5%

Almost all participants (87,5%) have answered that the share of knowledge had influenced the implementation of *Total Quality Management Programs*, namely with the definition of problem solving routines, project's technical specifications and quality standards.

75% of participants acknowledged that the *Project teams* had resulted from the new organisational structure and management practices. Only 25% of Technicians didn't agree.

62,5% answered that knowledge sharing had an impact in the creation/change of *New work processes* through teamwork implementation and the development of communication process (mainly through meetings to discuss project and organisational problems). On the other hand, 33% of Managers and 40% of Technicians answered that there had been no impact in creating *New work processes*.

62,5% referrers the creation of *Networking* trough informal relationships among Technicians that work on the same project and even among Technicians that worked in different projects.

Self Quality Control has increased because of the new management practices and especially because of the new project management, including mechanisms to hold each Technician responsible for the work outcome and the decision making process.

Only 37, 5% of the participants (all of them Technicians) answered that there was an *Increasing planning processes* trough project management technique such as Gantt and Pert charts (Program Evaluation and Review Technique) and CPM (Critical Path Method).

In the opinion of 37,5% of the participants, *Increasing dialogue* was linked to the meetings held for project discussion and to the Innovation Project workshops.

The item *Semi-autonomous teams* was referred by only 25% of the participants. However, in the group sessions it was clear that teams had the autonomy to make some decisions - the ones that were not too complex and that did not involve a lot of money.

Services externalization are only used when the organisation doesn't have the competencies needed to develop the work, and sometimes this is due to the clients demands. Only 12% of the participants have answered positively to that question.

d) Organisational structure

Decision making decentralization	62,5%
New hierarchical levels	50%
New organisational units	25%

Only 62,5% of participants answered that there had been a *Decision making decentralisation* with the implementation of the new organisational structure, since some decisions can be taken by project Managers and even by Technicians.

New hierarchical levels have changed because of the new matrix configuration of the organisational structure, but only 50% of the participants have answered that new hierarchical levels had been created.

New organisational units have not been created. The new organisational structure is dynamic and each project team is created according to the project, but all functional units remain stable.

e) Technology

Acquisition of new information and communication technologies	62,5%
Acquisition of new production technologies	50%

The *Acquisition of new information and communication technologies*, especially new technical software intended for technical drawing, was selected by the Technicians and Managers involved in the areas that acquired the software.

The *Acquisition of new production technologies* refers mainly to those intended for developing prototypes (although they are all prototypes since each product is unique).

f) Product development

Technical characteristics	62,5%
Storage	50%
Design	25%

62,5% of the participants have answered that *Technical characteristics* became more specific and have increased the quality of the projects.

Storage seems not to be relevant in automation and robotics, especially to the Technicians of that specific area.

Automation and robotic Technicians also assume that *Design* is not relevant in their business. Only 25% of the participants think otherwise.

g) Market

Product and services quality	62,5%
New markets	50%
Market share	25%

Product and services quality have increased with the new project control management techniques in the opinion of 62,5% of the participants.

50% of all participants assume that their share of knowledge helped the organisation's entrance into *New markets* by winning several international projects because of their competitive advantage – product customization.

Market share was only referred by 25% of the participants, but this number could easily increase because the company has won several international projects and became more profitable in 2005.

h) Process

Work cost	62,5%
Increase of production capacity	50%
Production flexibility	37,5%

Work cost changed because project delays have diminished and Technicians were allocated for shorter periods than before the project management implementation. This was the opinion of 62,5% of all participants.

50% of participants assume that there had been an *Increase of Production Capacity* because of the new work organisation in each project team.

In the opinion of 37,5% of participants, *Production Flexibility* has increased because teams have more autonomy in the organisation of their work and in making some decisions.

i) External relations

Increasing relations with suppliers	62,5%
Increasing relations with clients	50%
Increasing relations with other organisations	25%
Increasing relations with community	25%

In the opinion of 62,5% of the participants, the *Increasing relations with suppliers,* specially equipment suppliers, is because they have the power to influence projects' time frame.

Increasing relations with clients is important because they are the ones that define projects' specifications and their satisfaction with the final product it's very important.

Increasing relations with other organisations and the community are not a concern for most participants, but this has been made very clear during the group recall sessions – the organisation's external relations are very few and they have not changed after the Innovation Project.

j) Employee participation

Meetings	37,5%
Technical problem solving	12,5%
Improvement suggestions	12,5%

Meetings were implemented after the Innovation Project to share knowledge among project Managers and functional Managers. In some departments the meetings include the Technicians, according to Managers' opinion (37,5%).

Only 12,5% of the participants have referred *Technical problem solving*, but in the group sessions Managers and Technicians have point out the quality of problem solving routines and the informal knowledge sharing to solve projects' emerging technical problems.

Improvement suggestions, especially technical suggestions, weren't considered an important issue, despite the improvements deriving from the knowledge sharing process.

k) Knowledge management

Knowledge network	0%
Best practices repositories	12,5%

Knowledge network do not exist at EFACEC, Automação e Robótica.

Best practices repositories only exist in the IT Department and only the Technicians of that area referred them. These repositories centralize the best practices with the goal to increase knowledge exploration, and by providing accessible information.

l) Management practices

Project management	100%
Quality management	87,5%
Human resources management	75%

Project management is being implemented and has already allowed structure and work practices' reorganisation with the positive results of increasing communication, planning and controlling.

Quality management is also being implemented to allow the use of some problem solving routines and to contribute to the improvement of project's specifications and success.

Human resources management is under development, especially the connection between the new reward system and the performance appraisal, supported by the new Balanced Scorecard.

5.3.5.3 Analysis and Reflections

After the implementation phase, it is important to analyse the several organisational actors' perspectives about the knowledge creation and use process in EFACEC Automação e Robótica. The data collected in the groups recall made it possible to point out some relevant findings.

Managers are convinced that workers create and use technical knowledge. However, workers often assume a passive behaviour concerning organisational innovation practices and even in exploring new knowledge if they do not have the pressure of a new project.

Most employees do not have entrepreneur behaviour. They are always waiting for Managers to implement new organisational practices and processes or to change the existing ones. Even after the Innovation Project and the workshops, where all

employees had participated with new ideas, they still settled after a while and nothing new has been suggested to improve the working practices.

The Technicians agree with the Managers about their passive attitude towards organisational practices, pointing out that the organisation has a learning environment in respect to technical issues but not about the organisational issues. The Innovation Project helped them learn a lot about organisational processes and organisational changes.

Both organisational actors agree that the main reason for a passive attitude towards organisational innovation is because they work with strict time constraints and even if Managers urge workers to analyze their work, they have no time to make the analysis possible. They also miss the opportunity to learn from each other's errors and successes. If they could create more structured processes of knowledge analysis and share, they would naturally increase their opportunities to create powerful learning processes.

Another opportunity for knowledge sharing between Managers and workers in EFACEC is the annual performance appraisal meeting, where Managers and Technicians discuss that year's projects and define training needs. However, according to Technicians, the knowledge sharing between Managers and workers should not simply be an annual event. In their opinion, it should be the culmination of regular dialogue and feedback.

Other important aspect is that because technical knowledge is the major value of EFACEC, Automação e Robótica, they are always creating and using new technical knowledge, but the organisation does not have a structured system to make it explicit and accessible to all. Only the IT Department has created a forum where they store all the information regarding projects: helpdesk information, problem solutions, innovations, routines, and so on.

On the other hand, the share of knowledge is mostly made within each department and is not accessible to others. The Mechanical Department uses specific software to share knowledge. This software helps them create the machines' structures, and also to store important information: drawings, documents with technical specifications, budgets, cost, etc. However, only workers from that department have access to the information, which means that the knowledge share is only between departments.

It is also important to point out that the share of knowledge between Technicians and Managers is mainly made through technical drawings.

Finally, the organisation does not have a network of knowledge and it seems that Managers do not see the importance and the potentialities of this instrument in the share and creation of new knowledge.

EFACEC, Automação e Robótica is an organisation with a very high technological nature, mainly because of the projects' internationalisation. Technology could, therefore, be used as a tool to capture and disseminate data, information, experiences and know-how for subsequent utilization. This could potentially increase individuals' efficiency and their understanding of processes by bringing people, information and experiences together. Where there is a will there is a way, and no matter how geographically dispersed or culturally diverse an organisation may be, technology can be an effective tool.

A knowledge network could function as a basis for quality programmes, and to streamline knowledge sharing processes. This area was clearly identified by the Managers and Technicians as in need of improvement.

The knowledge network could also be used for training taking advantage of e-learning. This could be the answer for EFACEC, Automação e Robótica training constraints since some projects are developed abroad. With an e-learning system implemented through the knowledge network, workers could attend the training courses whenever they had the time and the courses could be customized according to the workers' needs. The network could also be used to share documents produced for and during the e-learning training process. It could also be a way of advertising the training plan, which, ultimately, could urge workers to develop their competencies.

The network will enable focused exchange among workers working on similar tasks, including the share of information from past experiences with which they could build the future projects. It could also provide all workers access to knowledge in specific areas, allowing knowledge sharing among workers, and facilitate the access to lessons learned, good practices and online evidence based resources.

In resume, a network could increase skills development and the capture of learned knowledge that could be of great use at EFACEC, Automação e Robótica.

Communities of practice (CoPs) could also be a great way of sharing knowledge. CoPs are groups of people who do the same sort of work, and who get together (on-line, or in person) to help each other by sharing tips, hints, ideas, and best practices. These communities can include professionals within an organisation, professionals from several organisations, or it can simply be a non-work-related community. People may not know each other but feel a sense of community because they have similar interests and face similar challenges. They realize the value of sharing knowledge with their peers, and of learning from each other. Communities or practice are informal and, while of great power to the organisation, are really focused on the benefit to the individual practitioners.

In respect to the introduction of the organisational innovations, it is possible to identify several benefits for the organisation:

- Workers' motivation have improved due to their involvement in the new definition of the organisational culture and goals;
- Managers have developed the skills needed to assume the role of quality assurance and can liaison between management and workers since they had leadership training during the organisational Innovation Project;
- The communication flow is more effective and participative and the Manager's role has been very effective in helping to gain workers commitment to the changes introduced.

Other expected results have not yet been achieved due to short time frame between implementation and now, but in the opinion of Managers workers' productivity has increased and the company is better prepared to face the demanding requirements of clients.

5.3.6 EFACEC Automação e Robótica: Research Conclusions

The need to innovate at EFACEC Automação e Robótica was created because of organisational problems faced by the business unit (BU). It was necessary to create a positive vision of the innovation process, regarding the future of the organisation.

The commitment of top management was very important, not only for the whole process of creation and sharing of knowledge, but mostly for its effective use and application. Top management was involved from the very kick off the process. The

main concern was to involve every employee and to define clear and realistic organisational change expectations.

Managers assumed a very important role in defining priorities, targets, in assuring communication, and in helping to create a stronger employee involvement and satisfaction. They tried to build constructive relationships with their team members in order to make the organisation achieve its strategic organisational goals. Communication, motivation, and leadership skills were developed in order to model new behaviours that they expected of the workers.

The Technicians tried to support sustainable problem solving and improvements and an alliance between organisational actors was created with the involvement and participation of everyone. It was a large-scale change because important aspects like the management style and organisational culture lead to the change of the organisational fundamentals.

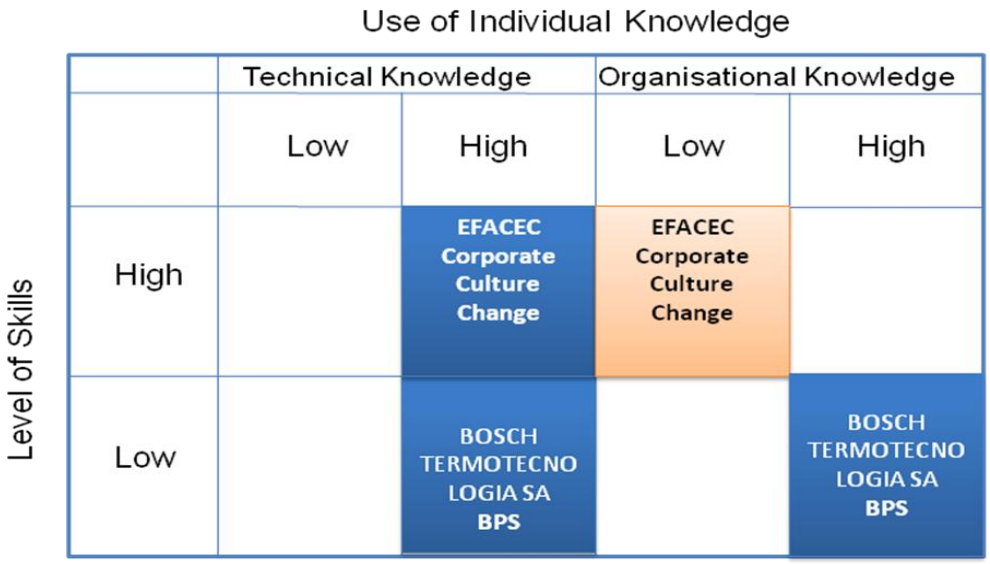
The employees' participation in the decision making process about what kind of change was necessary for the BU lead to a stronger commitment and the communication process was effective and helped the transmission of the innovation message during the implementation process.

Finally, the findings we made during the research process helped us realise that the organisational actors (Managers and Technicians) had similar perspectives about the organisation, and especially about the creation and transference of knowledge processes.

5.4 Comparing the Organisations

The empirical research shows how organisations use individual knowledge in organisational and innovation processes. The differences in the innovation process in EFACEC, Automação e Robótica and in BOSCH TERMOTECNOLOGIA SA could be explained according to two key dimensions that emerged from the analysis of the cases: the level of skills and the use of individual knowledge. Both dimensions and the positioning of both companies are depicted in Figure 19.

Figure 19 - The case studies



It should be pointed out that the positioning of the case studies in this framework was not a factor in the initial case selection, but emerged from the analysis process and the events interpretation in each case.

It should also be stressed that the positioning of the case studies reflects their relative location according to these two dimensions, and it is not intended to suggest that the cases represent in any way either the medium or the typical cases for that quadrant.

In the case of BOSCH TERMOTECNOLOGIA SA, the relevance of the continuous improvement program, combined with the impact on power and knowledge relations within the organisation actually contributed to the initiative being extremely effective and, as a result, it was easy to embed across the organisation.

Looking across both cases, when change initiatives interfered with (or were seen to interfere with) existing project management practices, the variety and distribution of these practices, together with the alignment of new practices with the existing ones, became important in defining whether and in what ways new organisational knowledge was accepted and embedded across the organisation.

The EFACEC, Automação e Robótica, SA case, for example, tried to involve all employers and Managers, and this helped explain the acceptance of their input into the project and, perhaps, the generally positive response to the initiative. The consultative way in which the change was introduced was also seen in positive terms.

In BOSCH TERMOTECNOLOGIA SA, organisational actors engaged in producing and reproducing organisational routines through learning as they continuously shared their knowledge. Consequently, their work practices changed.

In the cases examined, the perception of all organisational actors was very similar according to knowledge sharing practices.

The findings from BOSCH TERMOTECNOLOGIA SA, in particular, demonstrated how the embedment of organisational actors (Managers, Technicians and Operators) in relations based on power/knowledge mediated the learning associated with the diffusion of the initiative.

The EFACEC, Automação e Robótica case similarly highlighted the importance of differential power relations between different groups in the organisation (Managers and Technicians) that influenced the sharing of technical and especially organisational knowledge.

More generally, the findings across the cases demonstrate how knowledge sharing practices and routines that already existed had a profound effect on the creation of a culture of knowledge sharing, and on creating the conditions to implement new management practices and organisational changes.

Organisations exist in a particular place and historical context, which can facilitate, for example, the sharing, the flexibility of organisational structure, and management practices.

The challenge is to turn individual knowledge into organisational knowledge and to “lock” both explicit and tactic knowledge into the organisation. Upon implementing this, we can formulate a successful knowledge management strategy that will transform individual knowledge into organisational knowledge, thus increasing the value of the business. To express this idea and emerging from the action research process, a proposal of a model of knowledge sharing was developed showing the elements and relations between all the elements that compose the model that will be presented and discussed in the next chapter.

5.5 Recommendations to the Organisations

Some recommendations, which resulted from the research in the organisations, are in this approach based on empirical observations by the researcher and on the group recall sessions, together with established theoretical models from literature presented in chapter 3 and also with research dilemmas in chapter 4.

The main recommendations for EFACEC, Automação e Robótica were the creation of a systematic effort to share and use organisational knowledge within the organisational context so as to increased organisational performance, extending to all departments the IT Department tools to support knowledge management and specially knowledge reuse.

In the near future, there should also be a knowledge network established together with suppliers, clients and other institutions.

Creating and improving personal networks among workers with the goal to share their experiences from projects is also recommended.

More workshops should be scheduled to stimulate new ideas and knowledge sharing.

Following the example of the Innovation Project, the organisation should use incentives or rewards to increase the workers' participation and use the innovation office mechanisms to make suggestions and be more innovative.

There should be meetings at the end of each project in order to analyse the work done, and if necessary to change some of the used practices. Analysis of errors and problems should be done in a more structured way, creating a learning environment and benchmark other organisational practices. The organisation ought to be more open to the world, even within its own Group.

The main recommendations for BOSCH TERMOTECNOLOGIA SA were also: the scheduling of the workshops in a specific period of time to present and discuss the suggestions (this could increase the number of ideas and suggestions and deal with the time analysis constraints); the use of communication corners for weekly meetings to explain the information about the team performance and their results (this could help solve the problem of Operators' misunderstanding); extra training in all production's process because Technicians and Operators pointed out their limitations in knowing the whole product and not just the part they were working on; the creation of queries options in the quality databases so the information can be accessed by workers and Managers; regular visits to other factories and connection to different workers and Managers with the goal to benchmark other organisations' good practices; and, finally, the promotion of informal meetings among workers from the Bosch Group to share experiences and perhaps create some CoPs.

5.6 Impacts of the Research in the Organisations

This research was based on AR cyclical approach described by Susman and Evered (1978) (see chapter 3), trying to become closer to the standards set by positivists: contingency of the research findings, low control of the environment, and personal over-involvement.

One might argue that several researchers' opinions (Reason, 1988; McTaggart, 1991; Whyte et al., 1991), state quite clearly that their particular ways of doing AR constitute a desirable alternative to approaches used by positivists and that even casual observation affects a system and therefore causes effect inside its scope.

My personal involvement in the research have obviously impacted the research results, this is inherent in AR because it is impossible for a researcher to both be in a detached position and exert positive intervention on the studied organisation.

This is particularly true when the number of situations experienced by the researcher is small and the intensity of this involvement is high, especially when the research involves high share of knowledge among all organisational actors.

The main benefit resulting from successive iterations in the AR cycle is that disconfirming evidence in further iterations may help correct distortions in the findings of previous iterations caused by personal over-involvement.

My involvement in the research carried out at EFACEC, Automação e Robótica, SA and BOSCH TERMOTECNOLOGIA SA also indicates that AR interventions always influence some changes and change is always met with resistance by some, and support and enthusiasm by others.

At EFACEC, Automação e Robótica, SA I felt often inclined to favour certain explanations when Technicians implicitly assigned Managers' responsibility, but in several moments in the group recall sessions I could find some other explanation that helped me get a clear picture of some situations in the organisation.

My experience in the AR project at BOSCH TERMOTECNOLOGIA SA also suggests that both the organisation and the researcher's main goal should be to learn as much as they can from the research process. In this context, this research has made both organisations become more aware of knowledge as being intrinsically tied to their perceptions of their work, that is to say, the knowledge embedded within work practices.

In EFACEC, Automação e Robótica, the research findings confirmed that the organisation's work practices had an impact on knowledge management activities, making people more aware of the practices and even the knowledge that each department created and managed, like the lack of communication and the problems with time management.

In BOSCH TERMOTECNOLOGIA SA, new areas of business have been created and the organisation's efforts have been concentrated in exploring new products and new markets, but always in the search for more efficiency and more quality. Nevertheless, this was not a result of this study but a change in their competitive strategy. We assume that some of the knowledge shared during the research was relevant for all the participants in the process, making them think about some practices that were implemented and never questioned, like the visual management that was not really understood by Operators and even by some Technicians.

CHAPTER 6 – A MODEL PROPOSAL FOR INDIVIDUAL KNOWLEDGE SHARE AND USE

6.1 Introduction

This chapter is dedicated to the creation and analysis of a knowledge-sharing model. This model is intended to structure a possible framework and give practical instruments to help the knowledge use and share process among organisational actors and its use in business processes.

6.2 Model Proposal

This model proposal shows the relation between individual knowledge and organisational knowledge and the management practices that can enhance a culture of share. The main goal of the model is to help create a conceptual and empirical framework that contributes to promote the share of individual knowledge in organisations.

Two important variables that emerge from the research dilemmas are the involvement and participation of the workers in all the knowledge sharing process. At BOSCH TERMOTECNOLOGIA SA, they participated actively in the organisational life, solving problems, giving suggestions, participating in the workshops, in TPM teams, and discussing all kind of issues and problems among themselves in the communication corners.

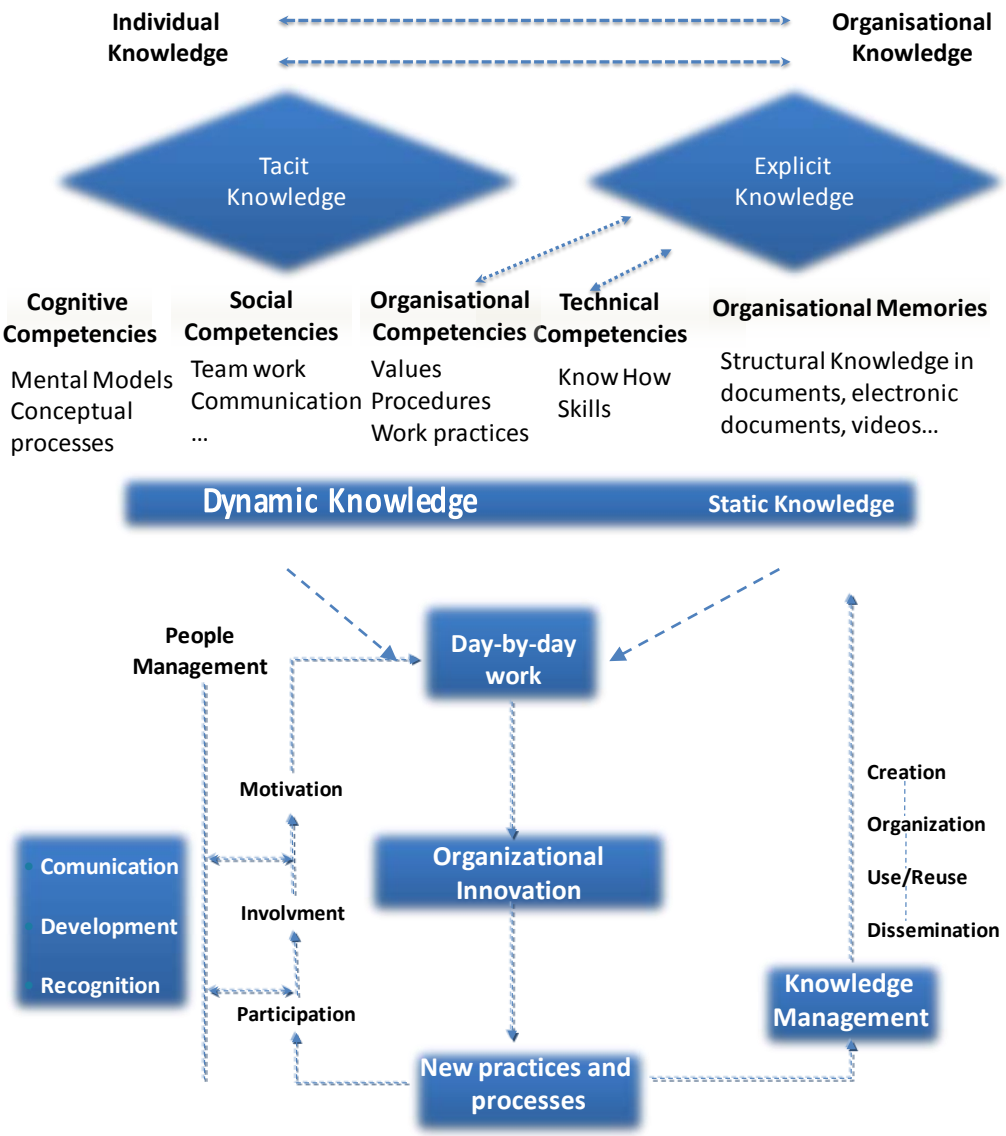
At EFACEC, Automação e Robótica, SA, they had the workshops during Innovation Project to give ideas, opinions and suggestions, but they did not have a similar culture of participation as in BOSCH TERMOTECNOLOGIA SA. The participation is restricted to the ongoing and specific projects and strictly related to technological issues.

However, the Innovation Project was the kick off to implement new practices, and Managers' meetings where the first way for them to improve the share and the involvement of all areas of the organisation in the project problem solving.

We should point out that both individual and organisational knowledge assume an important role for innovation and the implementation of new practices in organisations. However, none of this is possible if individuals are not involved in the process and if they do not feel that their own knowledge is important for their own development and for the development of the organisation.

The next figure will show the model proposal.

Figure 20 - Knowledge Sharing Model Proposal



The mix of individual (tacit) and organisational (explicit) knowledge based in cognitive competencies, social competencies, organisational competencies and technical competencies is within each individual (dynamic knowledge), and also in organisational memories (static knowledge). This mix is the crucial element for the life of an organisation, not only in everyday work but also for innovation and for the implementation of new practices and processes.

For all this to work, two elements need to be managed as one: people and knowledge.

Assuming that people are the source of all knowledge practices and that communication, competencies development and recognition are nuclear processes to

promote individual knowledge sharing, they are the main factor for the organisations' survival and success.

An important condition for implementing this model, and previously revealed from the field research, is the overcoming of obstacles to the knowledge sharing. In each dilemma we found several obstacles, namely organisational barriers, lack of transparency, organisational culture, habits, lack of incentives, inexistence of mechanisms that facilitate the share and even factors dependent from each individual. Knowledge may also be available but difficult to access whether because people are unaware of it, or because people are unwilling to make it available.

All knowledge dilemmas explored in this research were conceived around nuclear obstacles to knowledge sharing and this model tries to show that even with diverse types of obstacles it is possible to promote the individual knowledge share so that organisations may accomplish their goals.

6.2.1 The Mix Knowledge Model

The model shows two types of knowledge that can be shared in everyday work: individual knowledge and organisational knowledge.

6.2.1.1 Organisational knowledge

A large portion of organisational knowledge is connected to information repositories in the form of stored documents across the company. Relevant organisational assets are created and documented in different storage formats, such as text files, presentation slides, spreadsheets, web files, email messages, among others. These documents are a common source of information about the organisation.

Figure 21 - Organisational Knowledge

Organisational knowledge includes the information about the organisation's strategy, products and services, corporate image, management systems (human resources, financial, marketing, production management, among others) and the formal organisational structure.

6.2.1.2 Individual knowledge

Within the knowledge sharing and the use processes, workers continuously refine their organisational, technical, cognitive and social competencies.

Figure 22 - Individual Knowledge

To identify the competencies related to individual knowledge use and sharing, we will adapt Lopes et al. (1999) typology of competencies based on the typology of Guy le Boterf (1999) and Green (1999) (see 2.5.5 Knowledge as Competencies):

Competencies	Description
Technical Competencies	They integrate concepts about technical knowledge, including context and processes and operational methods and means. They are the basis for the organisations' strategic management of competencies. This kind of knowledge is easily shared because of its explicit nature.
Application in Organisations	
EFACEC, Automação e Robótica does not have these competencies mapped. As an action research researcher, the suggestion to this organisation was to develop a process of identifying most valuable competencies for the organisation (not only technical competencies but also organisational and social competencies).	
BOSCH TERMOTECNOLOGIA SA uses tables of competencies to identify the crucial competencies in each workstation.	
Competencies	**Description**
Organisational Competencies	They are the basis for the organisation to develop beyond its final products and complement the technical aspects of the work. They create a sense of community, which can lead to an increase of trust and commitment by the workers that share beliefs and behavioural rules.

Application in Organisations
In EFACEC, Automação e Robótica both Technicians and Managers have different visions about the organisation, especially about the organisational structure, even if they have the same perceptions about knowledge sharing. This becomes obvious when we analyze Managers and workers' actions, ideas, and thoughts. These different perspectives of the organisation may be a barrier to use individual knowledge in organisational dimension.
BOSCH TERMOTECNOLOGIA SA uses a shared language and common understandings linked to BPS, which are necessary to facilitate efficient communications and common understandings that focus on the essential role of trust, shared norms and common identification.

Competencies	Description
Cognitive competencies	They integrate complex thinking skills and analytical models used in problem solving situations, including problem identification and definition, recognition, analysis, implementation and monitoring.

Application in Organisations
In EFACEC, Automação e Robótica Technicians and project Managers use processes of reflection, including individual reflection and collaborative reflection, within the projects around specific technical and quality problems.
Through ongoing learning, including formal training, informal learning, observations and discussions, as well as work experiences, BOSCH TERMOTECNOLOGIA SA workers develop and refine their problem-solving capabilities. They approach many problems, particularly those of a routine nature, without a great deal of conscious thought about method or approach. When more novel and complex problems emerge, they recognize that they face something new that requires collaborative problem solving and therefore ask Managers for help. Sometimes workers discover problems that need cognitive skills including experimentation and modelling (like when they need a layout redefinition or when a machine is not fast enough).

Competencies	Description
Social competencies	These competencies include working habits, communication styles, leadership skills and teamwork.

Application in Organisations
EFACEC, Automação e Robótica developed teamwork competencies, communication, and informal and formal relationships by working in project teams.
BOSCH TERMOTECNOLOGIA SA's complex environment demands that problem solving be made by teams with cross-functional collaboration and interaction using social competencies to support collaborative work. Effective problem solving includes team building and maintenance activities, communication and conflict resolution skills.

6.2.1.3 Context knowledge

It is also important to mention the context knowledge, even if it is not present in the model. Context knowledge is expressed in situational features that represent additional knowledge that is crucial to the organisation's activity. A context change may influence the future of the organisation, and may cause changes in the organisational knowledge, as well as in the individual knowledge.

Figure 23 - Context Knowledge

Contextual knowledge includes information about the customers, suppliers, markets, competitors, employers' associations, financial organisations, among other external actors.

6.2.2 Dynamic Knowledge versus Static Knowledge

Most knowledge in organisations is *dynamic*, rooted in each worker, and a small part is *static*, rooted in documental information. It is essential that the dynamic knowledge can

be stored in repositories so that it can become a substantial source of relevant information and expertise.

However, knowledge flows much better under informal networks assuming a *dynamic* nature than through the hierarchical structure where *static* knowledge assumes a bigger importance in the form of reports, memos and other organisational documents.

Table 12 - Dynamic and Static Knowledge

Dynamic Knowledge	*Static* knowledge
Opinions, behaviours, ideas, and informal conversation. Workshops, communities of practice, and meetings.	Reports, memos, document procedures, databases, and other kind of organisational documentation.

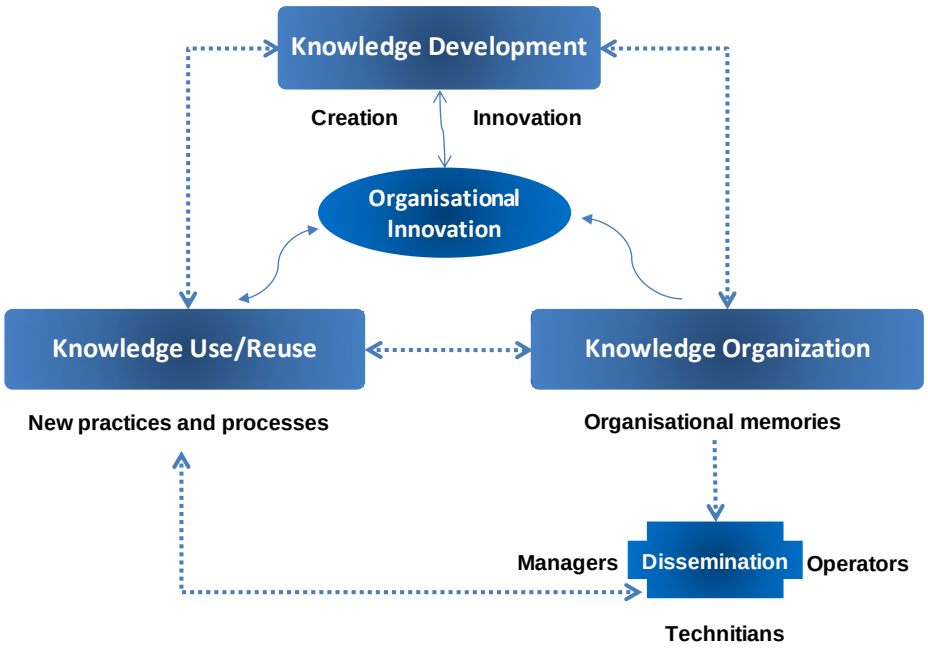
Middle Managers participate in the resolution of certain problems and develop strategies that could be learned by other workers and be applied in other areas of the organisation, capturing knowledge shared in real time - this is a process of capturing and reusing *Dynamic Knowledge*.

Effective capture and reuse of dynamic knowledge within the organisation, such as the capture of individual knowledge may be achieved using a common and shared vocabulary and this can be promoted by the creation of a culture of knowledge share.

6.2.3 Knowledge Sharing as an Organisational Innovation Processes

Knowledge sharing is itself a process of organisational innovation. In such context, organisational innovation is a means and an ending, needing to be modelled, structured, and partially formalised by the knowledge used and shared among organisational actors.

Figure 24 - Knowledge Sharing as Organisational Innovation Process



Organisations grow developing new knowledge based on creative ideas, on the use/reuse and adaptation of good practices, on failures and related lessons learned, and on daily individual and group experiences across the organisation. For example, an existing database system may support the knowledge developed in previous processes. If this knowledge is stored in organisational memories, it means that individual and group knowledge can be accessible by other organisational actors and it can be used to support new knowledge development.

6.3 Knowledge Profiles

Emerging from the model, organisational actors may assume one of several knowledge profiles.

The knowledge profiles are like a point of departure from *knowledge processes*:

- Creating new knowledge;
- Sharing knowledge;
- Using/applying knowledge.

and from *knowledge spaces*:

- A space for experiments – a space where knowledge is developed and applied;

- A space for learning - where knowledge is shared;
- A knowledge memory space – a space where knowledge is stored according to a specific organisational structure.

When combining these factors, we can find four knowledge profiles (a set of attitudes and behaviours):

1. *The Innovator* is an organisational actor that focuses his work on experiments to develop new knowledge and new solutions. He makes things happen and create results using existing knowledge in a process of experimenting.

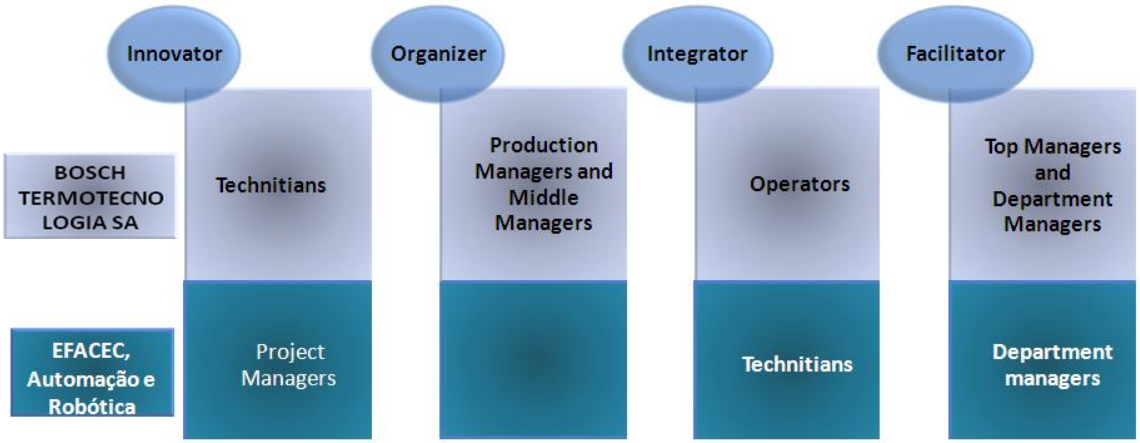
2. *The Organizer* is an organisational actor that prefers to create structures to explicit, collect, combine, and analyze knowledge. He creates mechanisms that transform tacit knowledge into explicit knowledge for future application.

3. *The Integrator* is an organisational actor that uses and integrates the knowledge developed and shared by all organisational actors, including himself.

4. *The Facilitator* is an organisational actor that promotes reflection, learning and tacit knowledge sharing processes. He makes sure that the right competencies are present when knowledge is applied in a controlled process.

Figure 25 - EFACEC, Automação e Robótica and BOSCH TERMOTECNOLOGIA SA

Knowledge Profiles



Organisations are different in many ways. Some require all the knowledge profiles, while others do not.

Applying the Knowledge profiles to BOSCH TERMOTECNOLOGIA SA, we have identified Top Managers, Department Managers and Production Managers as *knowledge facilitators*. They created an organisational environment that featured flexibility, high trust, a tolerance for risk and innovation, autonomy and supportive leadership. This is a context favourable to sharing and using individual knowledge. They are also very concerned with identifying and prioritizing areas for competencies and knowledge development based on the organisation's strategy.

EFACEC Automação e Robótica Managers can also be classified as *knowledge facilitators*, creating conditions, especially after the Innovation Project, for Technicians and Project Managers to share their knowledge, with innovation workshops and meetings.

As *knowledge organizers* it is possible to point out BOSCH TERMOTECNOLOGIA SA's Middle Managers and Production Managers as the actors that judge the complexity of the situations, understand the knowledge applied during each specific situation, adjust goals in real time, and organize structures that facilitate the integration of individual knowledge into norms and organisational procedures.

Middle Managers have the support of top management but sometimes they are free to make decisions in order to organize and implement new practices and processes. One of the most important responsibilities of Middle Managers is to train workers to transform their individual knowledge into organisational knowledge.

EFACEC, Automação e Robótica does not have an explicit organisational actor with a *knowledge organizer* profile. Each actor organizes the knowledge created and used in each project.

BOSCH TERMOTECNOLOGIA SA's Technicians can be identified as *knowledge innovators* because their activities include modelling, experimenting new practices and processes and teaching the new practices and processes to the Operators. They also focus on distinctive problem types and the approaches they take to work through these problems provides them competencies' development and the creation of new knowledge.

EFACEC, Automação e Robótica *knowledge innovators* are mainly the Project Managers, who are responsible for the creation of products and guides for the project teams to innovate in all the complex aspects of each project.

Operators are in BOSCH TERMOTECNOLOGIA SA the *knowledge integrators*, using their knowledge to solve problems. They have learned to quickly diagnose the nature of the problem and use examples of prior situations that they have learned of.

EFACEC, Automação e Robótica *knowledge integrators* are mainly the Technicians, who use their knowledge to build the products and equipments needed for concluding the projects with the quality and the utility defined by the clients.

These generic knowledge profiles have emerged from the group recalls, but each worker can belong to a different knowledge profile with specific competencies that characterizes that profile as unique. However, it is difficult to isolate a profile, as it is difficult to identify trends in an individual. Each individual has the capacity to be an innovator, organizer, integrator or facilitator, depending on the job performed or according to the individual's knowledge and skills.

The main goal is to understand the potentialities of each profile as a tool to help employees develop their competencies and become more skilful. In this context, it becomes necessary to define a set of competencies associated to each innovation profile to help organisations identify each worker's profile in order to enhance their potential and use this information to promote the individual knowledge share.

Table 13 – Knowledge Profiles Competencies

Profile	Competencies
Innovator	• Ability to use creative techniques • Ability to use scenarization and simulation techniques • Ability to use content analysis • Ability to create new knowledge • Ability to innovate
Integrator	• Ability to apply the accumulated technical knowledge into new projects • Ability to apply organisational knowledge • Ability to use individual knowledge in problem solving • Ability to work in a team

Profile	Competencies
Organizer	• Ability to create and organize organisational memories • Ability to create and manage knowledge centres • Ability for knowledge mapping • Ability to create and manage knowledge networks
Facilitator	• Ability to organize learning processes • Ability to share best practices • Ability to organize spaces of share, like seminars or workshops • Ability to develop young talents • Ability and knowledge to shape behaviour • Ability to encourage subordinates and co-workers to innovate and change • Ability to help subordinates and co-workers to participate and accept change

6.4 Conclusions

The model of knowledge sharing and use created as a result of this research presents several types of knowledge within organisations and identifies two important concepts – *dynamic* and *static* knowledge. The first one represents the knowledge that flows in the organisation and that is shared through informal interactions like conversations, teamwork, and problem-solving situations. The second one represents the knowledge present in organisational documentation such as reports, e-mails, presentations, videos, and other organisational memories.

It also points out the fact that the knowledge sharing and use activity is itself an organisational innovation process that has the potential of increasing the development of new knowledge used/reused in new organisational practices and processes.

As a result of the model analysis, a set of knowledge profiles emerged with specific competencies associated. They can be an important organisational tool to deepen the knowledge about the workers and Managers' potential according to a knowledge management process.

CHAPTER 7 – MAIN ACHIVEMENTS FROM THE RESEARCH

7.1 Introduction

The motivation for this research has its roots in a lack of a systematic development approach about individual knowledge share and use and organisational innovation processes. There was little or no support for connecting these two organisational issues, which have made it a very interesting challenge to embrace.

The research work presented in this thesis was grounded in the organisational settings of two Portuguese organisations. One of the organisations – BOSCH TERMOTECNOLOGIA SA – is implementing a production system and has been under substantial changes in its environment as well as in its internal processes before and during the time this research was conducted.

The other organisation, EFACEC, Automação e Robótica has developed an organisational Innovation Project with implications in the organisational structure and in the management systems.

The research in these organisations was conceptualized in 5 research dilemmas, formulated and described in chapter 1 and used in chapter 4 as a guide to the whole research. A summary of each research dilemmas and the lessons learned follows below with the research's main achievements.

7.2 Individual Knowledge Framework

1st Dilemma: "Literature emerges the idea that the use of individual knowledge accumulated through life and professional experiences is a competitive advantage for the organisations' success. However, sharing and transferring inexpressible knowledge is almost an impossible task to accomplish."

Tacit knowledge is highly related to the individual knowledge. Fleck (1996) stated that tacit knowledge is the kind of knowledge that is "wholly embodied in the individual, rooted in practice and experience, expressed through skilful execution and transmitted by apprenticeship and training through watching and doing forms of learning".

According to Baumard (1999, p. 2), "tacit knowledge (. . .) is something that we know but cannot express". Tacit knowledge is knowledge that is difficult to express in words

or to codify in documentation. It includes both physical skills, such as the ability to ride a bike, and cognitive frameworks, such as the value system people possess.

The embodied nature of tacit knowledge means that successfully sharing requires active and direct communication between individuals (Lam, 1997; Storey and Barnett, 2000). Thus, tacit knowledge is typically shared socially through language and stories (Brown and Duguid, 1991), through the observation of practices that others undertake or through a process of learning by doing within a communal context (Lave and Wenger, 1991). The tacit knowledge embedded in social and cultural values further increases the difficulty in sharing it.

Each person has his unique knowledge but by integrating such knowledge into organisational knowledge, organisations can reduce the dependency on the distinctiveness of such individuals.

On the other hand, if individual knowledge is not shared with others it will have very little effect on the organisational knowledge basis. Therefore, one of the important tasks for management is to facilitate the process of interaction between employees and make them sensitive toward environmental stimuli. Their individual knowledge will then be amplified and internalized in order to contribute to the organisational knowledge base (Nonaka, 1994).

The strategy for an organisation to increase knowledge sharing can be developed by Managers promoting strong teamwork within employees' work groups, whereby supervisors and co-workers provide encouragement for contributing to as well as using available knowledge gained and stored in the form of explicit knowledge.

In BOSCH TERMOTECNOLOGIA SA, knowledge sharing among workers is based on long years of experience, face-to-face communication and problem solving situations. The main processes used to share explicit knowledge are procedures sheets, several databases (quality, problems and solutions, and products) and documentation (reports, product specifications, manuals).

In EFACEC people share individual/tacit knowledge within-projects and explicit knowledge in post-projects. Workers participate in project teams and the teams change according to the project in course, the competencies needed and the existing human resources. In this case, they share and use their accumulated experiences in the new projects. After project completion, the documentation is stored and if necessary made accessible, but because EFACEC, Automação e Robótica doesn't have a structured

knowledge management system each department has the information regarding to the activities they developed during the ongoing project without any interconnectivity between the information, which makes the access very difficult.

The IT Department is the one that has more structured routines of knowledge sharing, using virtual Fora to post all the information regarding projects, but this knowledge is accessible only to the people that work in that specific department.

As to organisational knowledge, the Innovation Project played an important role because all the workers have participated sharing their ideas and opinions about the new directions and organisation strategy.

The Technicians and Managers perceptions about knowledge sharing are similar: both refer that there is an amount of technical knowledge share, but not organisational. The Innovation Project was a moment of organisational knowledge sharing, but did not create a routine of share.

Individual/tacit knowledge can be a competitive advantage, but it needs to be captured and transformed into explicit knowledge in order to be accessed and used in the future. It is a very difficult process because of the nature of that kind of knowledge and because even when people share it there is always some part that is lost.

However, the research showed that some organisations have methods that facilitate the share and use of individual knowledge.

BOSCH TERMOTECNOLOGIA SA captures individual knowledge and stores it in databases, procedure and problem solving sheets. Another situation is when workers are leaving the organisation and there is a period of time for them to work overlap to transmit the knowledge to another colleague.

They also use other ways to explicit knowledge like through e-mail, documents and discussion groups. All procedures are documented and made available in the intranet, accessible for all workers. Visual management is also very important for BOSCH TERMOTECNOLOGIA SA: they use charts, models, illustrations, photographs, plans of work in maps, and tables.

Managers at EFACEC, Automação e Robótica pointed out that they needed to improve the process of transforming individual/tacit knowledge into explicit knowledge. This is a critical process that needs to be developed because tacit knowledge is their most important competitive advantage to win big international projects, and if the most qualified and experienced workers leave the organisation they will be in serious trouble.

Technicians referred that in the workshops during the Innovation Project they suggested the creation of a global forum for the organisation, but this idea was still not implemented. The explicit knowledge is only available in drawings and accountability sheets, but these are not accessible to everyone in the organisation except for those who work in a specific project.

Their main processes of explicit knowledge are through e-mails, documents and project meetings. They have an intranet but they do not use all its potentialities since they do not use it to search the knowledge available (in papers, articles, technical files, and other documents).

The following table shows transferable (explicit knowledge) and non-transferable knowledge (individual/tacit knowledge):

Table 14 – Transferable Knowledge

	Transferable Knowledge	**Non transferable knowledge**
Internal Resources	• Internal training • Technical information • Internal workshops	• Work experiencies • Relationships with co-workers
Resources (internal/external)	• Schools and Universities • Employers associations and Professional associations • Databases about markets and products	• Previous work experiences • Relationships with other organisations • Informal networks

When individual/tacit knowledge becomes explicit, it is important that it can be understood and used by workers. However, this is not always possible to achieve. In BOSCH TERMOTECNOLOGIA SA, for instance, this is a crucial difficulty since Operators have difficulty in understanding the information displayed in the plant, especially understanding the figures and charts displayed, but also the language used by the Technicians – according to Operators, Technicians sometimes use a very complex language. Operators have pointed out the importance of choosing a simpler way of displaying and communicating information.

Production Managers have a different perception because they assume that the lower level of Operators' qualifications is what conditions their understanding. They already

use a simple language and the charts are coloured, but Operators still find it hard to understand due to their level of qualification

Department Managers agree that the formats and the language could be simpler. They showed interest in overcoming that situation by investing in communication development and by using easier formats in order to facilitate the process of understanding. They assumed that this is a continuous learning process and underline the fact that Visual Management is a means to create the willingness in workers to know more and to understand the impact of their work in the factory's productivity.

Middle Managers point out the fact that some Operators are afraid to show that they don't understand the information, so they don't ask for any explanation.

BOSCH TERMOTECNOLOGIA SA invests a lot in communication as a knowledge sharing process, not only explaining the production figures, but also discussing problems and solutions.

This is a continuous training process that is used to make workers share, understand and assimilate new knowledge. They participate in specific projects (like TPM projects) and problem solving situations (in problem solving teams), which helps them develop their competencies and knowledge.

In EFACEC, Automação e Robótica, the explicit knowledge shared is basically technical, and it seems that Technicians, mainly Engineers, do not have any difficulty in understanding it.

7.3 Individual knowledge – Strenghts and Barriers

2nd Dilemma: "The use and share of employees' individual knowledge is an important factor to solve problems and strengthen performance. However, several organisational and individual barriers condition the process."

Knowledge sharing can increase problem solving, improve teamwork performance and job effectiveness, and enable rapid reaction to new information (Song, 2002; Lee & Choi, 2003). By using knowledge regularly in problem-solving, workers develop a pattern of experience and some competencies, which they can use on a particular problem and quickly detect a solution.

Organisations map workers' competencies to develop workers' potential in order to improve their results. BOSCH TERMOTECNOLOGIA SA uses competencies maps as an important management tool in each section of the plant. Knowing workers' competencies can make it easier to organize people's work and activities, to establish a rotation of personnel, or to replace workers when needed.

Production Managers and Middle Managers have the same perception about mapping competencies. Another advantage is the possibility to implement a mobility system improving flexibility in production and potentialize workers' learning and knowledge development.

Managers in EFACEC Automação e Robótica aren't aware of the workers' competencies. Project Managers know informally the Technicians' competencies and in the Performance Appraisal process they analyse the lack of key competencies.

Knowing the more knowledgeable workers and their competencies makes it easier to identify the workers that should be in the teams that solve problems that are more complex.

BPS gave BOSCH TERMOTECNOLOGIA SA a good system of problem solving since workers have autonomy to solve less complex problems, and each problem and its solution is registered in a database that can be searched when a problem occurs, thus facilitating the use of knowledge. However, individual knowledge is the crucial factor to identify the problem and the possible solution.

In their daily work employers face several problematic situations and the most of the times they solve them in an unconscious (tacit) and automatic way within a few seconds. Other situations require more time, effort, teamwork and collaboration.

All organisational actors from BOSCH TERMOTECNOLOGIA SA showed the same perceptions about problem solving processes and workers' participation in the solution.

In EFACEC, Automação e Robótica, individual knowledge is highly relevant in problem solving situations because Technicians are geographically dispersed and they need to make some decisions and solve some problem situations with autonomy. They have compliance routines to help solving technical problems, but organisational problems are solved by the Managers.

Applying new knowledge can have several consequences, like changing products, processes or organisation. These changes can be extended to work practices and processes, which can raise barriers and resistance.

In BOSCH TERMOTECNOLOGIA SA, Managers, Technicians, and Operators agreed that at first there was some resistance from workers to all BPS changes. Nevertheless, the company is continually changing and BPS imposes the constant creation of new knowledge, especially regarding the organisational innovation process. Managers were able to involve all workers in this process, which required the use of management tools, the development of communication, and the promotion of workers participation. All of BOSCH TERMOTECNOLOGIA SA organisational actors have the same perceptions about the effort made to create strong ties among themselves.

Another important factor is the week hierarchical barriers between employees and Managers, since they work very closely in the plant and as a team solving each problem. Middle Managers are especially participative in the resolution of certain problems and they developed strategies that could be learned by other workers and be applied in other areas of the organisation, capturing real-time knowledge share.

According to Lee & Choi (2003), the lack of trust among employees is also one of the key barriers preventing knowledge-sharing activities.

In EFACEC, Automação e Robótica, some workers did not participate in the organisational Innovation Project with the same enthusiasm as others co-workers sharing their ideas and opinions and contributing for the development of the organisation's new strategy. Several factors like fear to be misunderstood and misinterpreted, or fear from the perceived value of knowledge made by the other Technicians and Managers could be the main causes for not sharing their knowledge.

It seems that relationships in EFACEC, Automação e Robótica present a lack of trust. When there is a trust environment among workers, they become more willing to participate in knowledge-sharing activities (Abrams et al., 2003; Lucas, 2005).

Of course, there are other social, behavioural and psychological barriers like individualism, deficient means of knowledge capture, inadequate technology, internal competition and top-down decision making.

To overcome these barriers there are some factor that could be crucial: management's attitudes, employee involvement, reward systems to induce knowledge sharing, and knowledge networks (Gold et al., 2001; Templeton et al., 2002; Taylor & Wright, 2004).

7.4 Developing a Knowledge Sharing Culture

3rd Dilemma: "Using and sharing individual knowledge is crucial to organisational innovation processes, but organisational culture and management resistance makes it very difficult to promote employee's involvement and participation."

Knowledge sharing should be an everyday activity, and Managers are in position to develop learning strategies and real-time mechanisms of knowledge share, even if dynamic interactions can be made simple through interactive communication between individuals.

Empowering employees with some autonomy in specific tasks, and providing meaningful learning experiences can offer increase agility to the organisations' knowledge culture.

As a research result, we found some elements that can influence the creation and development of a knowledge sharing culture like leadership, organisational structure, informal networks, reward systems, time available, business processes, technological infrastructure, individuals' competencies, and motivation.

Manager's leadership is crucial to encourage knowledge creation, share and use/reuse to solve problems. They are in the right place to perceive how knowledge can be applied in other areas of the organisation.

To potentialize the learning within teams, Managers can develop the means for individuals to learn, focusing on special tasks that need information sharing. Because of this, Operators might change their norms concerning their work.

The management style can be based on a tutorial and coaching approach. It is possible to involve workers by building meeting places in the shop floor where Operators get information about work practices, production issues and teams' productivity. Making decisions though communication and dialogue is something quite different from making decisions only based on hierarchy, which has been the traditional way of doing things.

These places also can improve the ability to discuss problems in the work process and establish individual, team and organisational learning.

Literature emphasizes Manager's leadership and development of organisational culture (Ribiere and Sitar, 2003; Bixler, 2002; Bonner, 2000; Ellis and Rumizen, 2002; Schein, 1996). Leadership from senior management is important, but it is essential that Middle Managers demonstrate leadership attributes to develop and support the knowledge culture throughout the organisation.

Studies revealed that Middle Managers determine the success of the knowledge culture development in a given organisation. However, the studies also reveal that in some cases KM programs have not succeeded in certain divisions due to the lack of support from lower level Managers despite the support from senior management. In other cases a few divisional Managers initiated KM programs and created knowledge culture in their respective teams with little support from senior management (Kluge et al., 2001; Marsh and Satyadas, 2003; Welch and Welch, 2005).

Traditional *organisational structure* needs to be transformed to support the development of a knowledge culture. The main knowledge management activities are attached to such functions such as sales, product development, manufacturing and customer service.

Developing *informal networks* with internal and external actors underpins successful collaboration. Lave and Wenger (1991) created and described the term "communities of practice" (CoPs) as "an activity system that includes individuals who are united in action and in the meaning of action for them and for a larger collective". CoPs can play a significant role in resolving product issues, solving customer problems and assisting in expanding sales. Facilitating and promoting CoPs was seen as an important element of knowledge management programs in many of the organisations explored in several studies. The Senior Managers regularly recognized and valued the employees' participation in CoPs, wherever such participation has resulted in visible organisational benefits.

Researchers like Davenport and Prusak (2000), Gupta and Govindarajan (2000), point out that organisational *rewards* motivate employees towards knowledge sharing and foster a knowledge culture. There is a demarcated line between direct and indirect rewards. Indirect rewards such as appreciation and recognition play a greater role than monetary incentives. Moreover, in promoting knowledge culture long-term rewards

such as profit sharing and employee share options were observed as effective means when compared to the short-term incentives.

On the other hand, some employees may be involve in knowledge activities because of the intrinsic drive for learning, personal contentment, peer recognition and self-actualization. Recent studies in the subject also confirm that these behavioural motives play a major role in knowledge creation and sharing (Ardichvilli et al., 2003; Darwin, 2004; Malhotra and Galletta, 2003; McLure and Faraj, 2000).

Only one of the organisations studied in this research – BOSCH TERMOTECNOLOGIA SA – had formal processes in place to appraise knowledge contributions of the employees, especially with ideas and suggestions. They have a suggestion reward system that functions by the accumulation of point.

Time allocation for workers' knowledge activities is a crucial element in developing a knowledge culture. Time is needed to learn, collaborate, create knowledge, and share activities. The pressure is constant when it comes to productivity, and deadlines condition the possibility of finding time to add lessons learnt to the knowledge database, or to share that knowledge with colleagues.

Time is a negative key factor for EFACEC, Automação e Robótica to create habits of knowledge sharing because of the difficulties shown in attending training courses and in participate in project meetings. Perhaps a gradual approach beginning with a pilot project in knowledge sharing could be implemented in the IT Department, which seems to be more open to knowledge sharing activities. Recent studies in the area also indicate limitations in achieving organisation-wide knowledge culture in a single instance, and suggest the pilot project approach (Paul, 2003; Reinhardt, 2005; Rumizen, 2002).

Business processes are an important factor for developing a sustainable knowledge culture. Davenport (1998) advocates that knowledge is generated, used, and shared intensively in specific processes. In BOSCH TERMOTECNOLOGIA SA knowledge is used in order to create or change processes. This idea is also supported in the studies conducted by Remus and Schub (2003). It is essential to integrate knowledge share activities in the business processes to enable the flow of knowledge in the everyday organisational life. These processes can help spread knowledge sharing activities from a few teams to the whole organisation (Nissen and Levitt, 2004; Wenger, 2004).

Individual knowledge share strongly depends on face-to-face relationships (Spring 2003) and, therefore, the use of a *technological infrastructure* is only partly possible. However, it is possible to transform part of the tacit knowledge in explicit knowledge through formal language and electronic storage.

The most critical process in knowledge sharing is the human factor and not the electronic and networking tools since it is the *individual competencies* that drive the knowledge management in an organisation. These competencies include:

- Ability to filter information in an information overload environment
- Ability to analyze information and understand it
- Ability to synthesize information
- Effective reading
- Concise note-taking
- Effective communication with others
- Effective share of knowledge

These competencies demand that they be developed though training. That way workers can learn strategies in order to get relevant information without reading voluminous information and to develop creative approaches towards knowledge acquisition and sharing.

Individuals' motivations depends on the workers' believes and if they perceive that knowledge is respected, valued and used in organisational processes.

Finally, it is important to point out that the culture goes hand in hand with the structure (roles and responsibilities). At every level within the organisation, there must be congruence between objectives, structures, processes, people and supporting infrastructure.

7.5 Mechanisms to Promote Knowledge Sharing

4th Dilemma: "Organisations need to promote individual knowledge sharing among all organisational actors, but organisations didn't see the need of creating mechanisms to promote this sharing."

Knowledge sharing within organisations can be strengthened by a variety of methods like training programs, online discussions, presentations, workshops, and informal networks that can encourage the knowledge sharing within the organisation. Both organisations studied (BOSCH TERMOTECNOLOGIA SA and EFACEC, Automação e Robótica) have regular internal magazines, journals and newsletters to spread information.

Other knowledge artefacts are templates, guidelines, best practices, case studies, expertise notes, knowledge maps and workflow charts.

EFACEC, Automação e Robótica began to organize and create project reports to store all of the project's information when they are ending. That way the knowledge generated can be captured.

The reports cover topics connected with the customer, project problems, troubleshooting, lessons learned, rationale and best practices. Project Managers are the ones responsible for these reports and they are also at the beginning of the whole process. It would be important to make these reports accessible to the whole organisation.

TO capture customer's knowledge is also an important factor and this is evident in BOSCH TERMOTECNOLOGIA SA since the company uses client's knowledge to improve their products. Literature also emphasizes that gaining customer knowledge is a competitive advantage, and advocates its use in product development and service delivery (Drucker, 1999; Gebert et al., 2002; Hammer, 1990; Österle, 2001; Porter and Millar, 1985).

Technological infrastructure like Fora, virtual networks, and intranets are the most common infrastructures observed in both organisations analysed in this research. Other recent studies (Detlor, 2004; Gottschalk and Khandelwal, 2004; Spies et al., 2005) have also found that knowledge portals play an important role in knowledge activities.

Through these portals, people can access, create, organize, share and use knowledge. Knowledge portals can be an effective way to provide open access to all relevant information.

Organisations can also extend their knowledge access to their business partners and customers, even if certain areas will have to be restricted. This can play an important role in collaborative product development, service delivery and project accomplishment.

Literature assumes that technology takes superfluous lead role in knowledge sharing processes (Malhotra, 2004; Wilson, 2002; Ruggles, 1998). However, technology can significantly promote a knowledge culture by changing employees' habits in terms of communication, collaboration, information sharing, learning and decision-making. This was evident in EFACEC, Automação e Robótica group recall sessions where IT Technicians pointed out the importance of the Fora, and the search possibility for relevant information in order to accomplish some tasks. They also emphasized the power of the Internet, where they can find programming routines that help them to solve some technical problems.

The physical configuration of the work environment also influences the knowledge culture in organisations. Structural characteristics such as shared areas, cubicles with low dividers, open spaces and other informal meeting amenities can help people in the process of social networking. These physical characteristics can facilitate the flow of knowledge across the organisation.

BOSCH TERMOTECNOLOGIA SA has workshop rooms, common dining halls and communication corners. These shared spaces have contributed to the development of the knowledge culture by facilitating informal collaboration between workers. They provide a high interaction between people from various functional departments and aid in the knowledge sharing process.

Based on observations and the annotations from group recall sessions, it can be asserted that both physical structure and design of the work environment play an important role in the development of the knowledge culture. Extensive literature in social behaviour, architecture and knowledge management also suggests that organisations should consider these workspace characteristics to promote employee collaboration and a knowledge sharing culture (Anderson et al., 2001; Cohen and Prusak, 2001; Chiem, 2001; Girard, 2004; Kolleeny, 2003).

7.6 Individual knowledge Use - a Source of Competitive Advantage

5th Dilemma: "Knowledge is recognised by researchers and practitioners as a fundamental asset to organisations' survival. However, organisations don't integrate and effectively use new knowledge created or developed by employees."

Tacit knowledge is a source of competitive advantage. The creativity necessary for innovation derives not only from obvious and visible expertise, but from invisible reservoirs of experience which need to be shared first, before being used in the innovation process.

Organisational learning is dependent not only on the access to knowledge, which may be increased through organisational networks or other inter-organisational interactions, but also depends on the ability to integrate that knowledge (Powell et al., 1996; Chesbrough and Teece, 1996).

BOSCH TERMOTECNOLOGIA SA has demonstrated this awareness by restructuring the organisation to ensure that Managerial resources are available to continue inter-organisational engagement and to embed that learning in innovation.

Individual knowledge underlies many competitive possibilities when is deeply embedded into organisation's practices. It includes relationships, norms, values, and standard operating procedures and it is very hard to detail, copy, and transfer. Therefore, it is a sustainable source for competitive advantage in organisations.

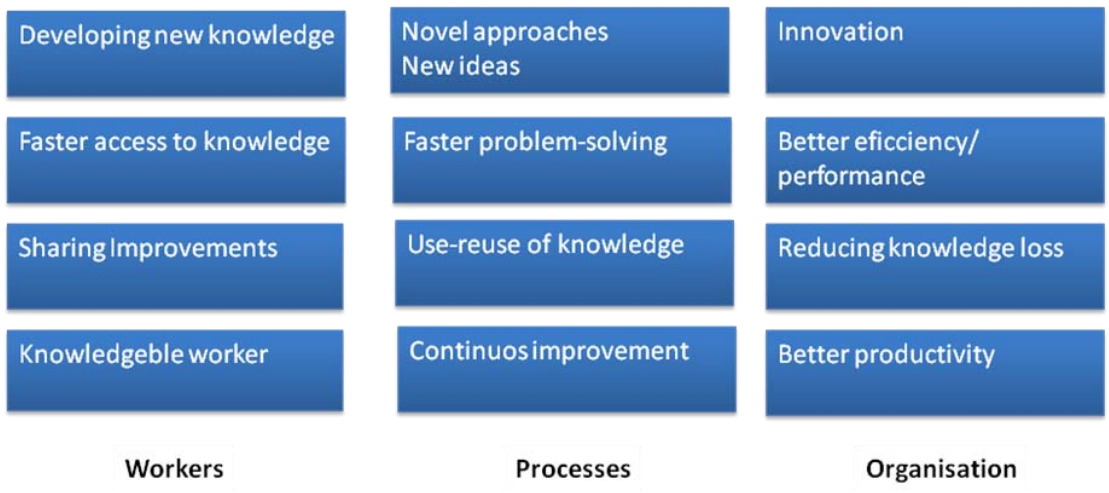
Inaccessible from explicit expositions, individual/tacit knowledge is protected from competitors unless key individuals are hired away.

To overcome this situation, today's organisations promote teamwork and knowledge sharing and use. As an example, workers spending several years in one organisation and building up their own unique way of working do not even have the perception about the deep tacit knowledge involved in the process.

Individual knowledge can be very important to others because knowledge derived for one need may be helpful in very different contexts; or it may be a trigger for innovation - many innovative developments come from making knowledge connections across different disciplines and organisational boundaries.

Knowledge management can be successfully implemented though many levels, each having many benefits for a successful organisation.

Figure 26 – Knowledge Benefits



The benefits for workers derived from a more efficient processing of information and knowledge by, for example, eliminating the duplication of efforts or saving valuable time.

The benefits for processes could be translated into benefits that can be expressed in terms of efficiency or effectiveness. Databases are a common example since they help eliminate less efficient operations by reusing knowledge.

The impacts on organisations affect some of the organisation's key goals, such as productivity, performance and innovation.

Moreover, knowledge sharing can also be viewed as organisational innovation with the potential to generate new ideas, develop workers' competencies, and create advantages for the organisation.

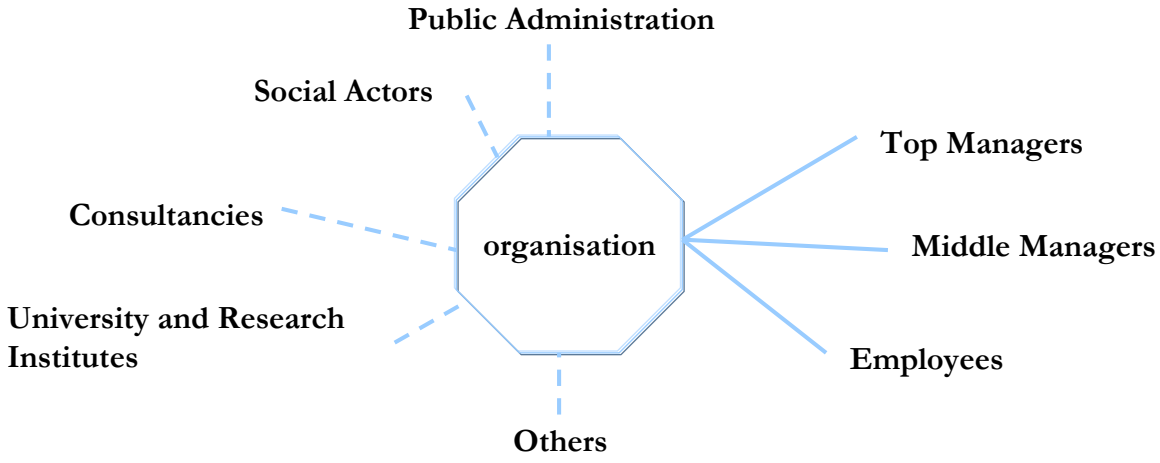
7.7 Organisational Actors Role in Individual Knowledge Sharing Processes

Organisational actors assume important roles in individual knowledge sharing processes. An internal important asset is knowing employees and Managers' capabilities and what improvement could be made to build up their accumulated learning and, therefore, enhance individual competencies.

Outside the organisation, there may also be important knowledge that needs to be captured from other organisations, through recruiting individuals with suitable qualifications or work experience, engaging appropriate consultants, by building networks with other organisations.

The following figure shows the organisational interactions among internal organisational actors (Top Managers, Middle Managers, employees) and external actors (consultants, universities, research institutes, public institutions, and social actors).

Figure 27 – Organisational Actors' Role in Knowledge Sharing Processes



Employees have different skilled frames that condition their perceptions about the organisation. They also show diverse viewpoints, which are important for problem solving and to develop new ideas. Their potential can be channelled with diverse techniques to share and use their individual (tacit) knowledge (like brainstorming sessions in meetings and workshops).

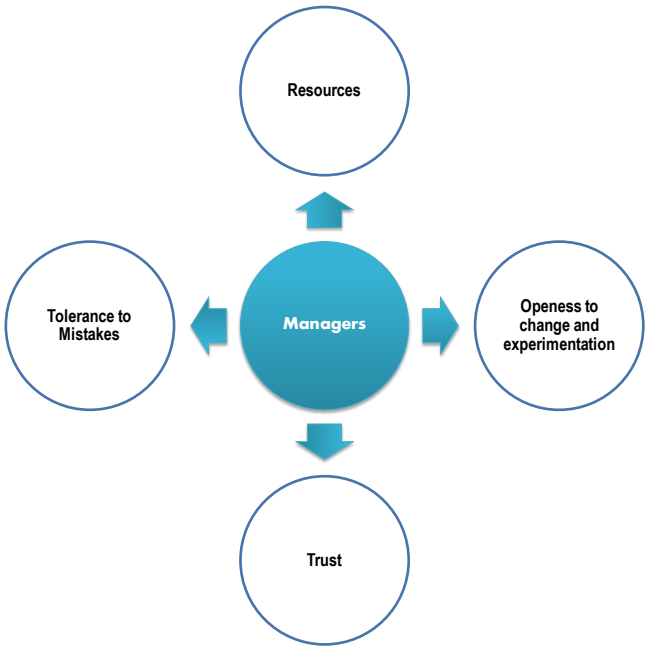
Meetings are a unique space for knowledge sharing and for continuous learning. As an example, sharing knowledge about finished projects (including products, processes used, the problems that occurred and the solutions applied). Besides sharing project results, a learning process will occur simultaneously. Meetings are also spaces to discuss problems and solutions, new ideas or new products/services, new strategies, or a new practice or process.

Managers' role can be very crucial in transforming knowledge sharing in an everyday activity, directly affecting the development of a knowledge sharing culture.

Managers know their organisation very well. They know the procedures and how to get things done. They often translate top management's ideas into workable solutions and also understand the front line workers' needs and are able to bring important issues to the attention of Top Managers. They use their skills and knowledge of the organisation to implement procedures, solve technical and human problems.

Their role includes empowering subordinates, allocation of resources, openness towards change and experimentation, developing trust, tolerance to mistakes and building long-term perspective of the organisational goals among employees.

Figure 28 – Managers



External actors like the *Public Administration* can be seen as a promoter of innovation and knowledge share. They have the responsibility to provide information dissemination, free training and seminars on the new management techniques. They also should be a provider of financial support and funding to promote innovation and knowledge management methodologies and tools. The Public Administration can also have a key role in facilitating research collaboration between the industry and the academic sector, which can be vital to understand the needs of industry and establish policies and legislation to encourage innovation. EFACEC and BOSCH TERMOTECNOLOGIA SA have used some public funds to implement several projects, especially regarding technology.

Universities also can play an important role in the development of management knowledge. They are responsible for the creation of future Managers for companies as

well as consultancies. In the last two decades, Universities have created business schools that became developers and promoters of innovation and knowledge development. From the development perspective, it is important to point out the contribution of academic specialists. They are researchers with a high specialisation and integrating business schools. Many of them develop part of their research activity directly in academic centres, and combine academic and research work with consulting activities. The academic work carried out, for example in the form of doctoral dissertations, has the power to transform their unique competence into common knowledge. Business schools also influence the consultancy field with research on customer-needs (customer relationship management) and competencies (creativity development, knowledge mapping). The information is then shared (e-learning, cooperative intranet, telework technologies), organised (project management, business plan) and disseminated (marketing of innovation, spin-offs).

BOSCH TERMOTECNOLOGIA SA uses University (especially Aveiro University) as a source for recruitment, especially for its R&D Department. They also cooperate in some R&D projects, the main one is the Intelligent Heat Water System together with INEGI.

Consultancies generate knowledge developers and users. They can store and transfer their knowledge through the development of a range of tools and techniques, but they also point out the importance of the context in which they operate. These actors might be seen as developers of new innovation management methodologies, rather than as agents for the transfer of existing technology into new sectors of application. What distinguishes consultancies from the other actors is their close interaction with management practices. Therefore, it could be argued that consultancies actually derive most of their knowledge, if not all, from their client organisations.

The partnership with consultancies happens in several areas on both organisations under study. In EFACEC, Automação e Robótica, for instance, it happened during the Innovation Project when they used a specific methodology and the support of a consultancy agency. The Environment Survey was also made by a consultancy agency. In respect to BOSCH TERMOTECNOLOGIA SA, they also use consultancies' services in Quality, Financial, Human Resources and Technology.

Finally, *Industry and Trade Associations* can build up extensive networks among organisations within their area of responsibility at low or zero cost to the firms themselves. Encouraging people to share their acquired knowledge within the firm is a

major challenge, and possibly one that can be encouraged within the knowledge-driven economy by the application of technology-based tools to support this process. The AIMMAP (Associação dos Industriais Metalúrgicos e Metalomecânicos e Afins de Portugal), develops several activities with organisations like BOSCH TERMOTECNOLOGIA SA and EFACEC, Automação e Robótica, SA, mainly training and consultancy activities.

7.8 Lessons learn

The key lessons from this research have theoretical and practical implications. Both are discussed in the following chapters.

7.8.1 Theoretical implications

The reflection about knowledge sharing and use helped conceptualize an important asset of this research: the concept of *Dynamic Knowledge* which can be defined as *the share of knowledge during a work process, for instance in the resolution of a certain problem or in the development of strategies or practices that could be learned by other workers and be applied in other areas of the organisation, allowing real time capture of the knowledge*.

Beside the *dynamic knowledge* concept, the main contribution of this research is the model for knowledge sharing in organisational innovation processes and the knowledge profiles.

The profiles can be considered a management technique used to help organisations to identify workers' potentialities in terms of knowledge management and to develop workers' competencies in one specific direction, helping them to develop their competencies to fit in the most adequate profile according to present competencies and the worker work activity and potential.

The model shows the relation between individual knowledge and organisational knowledge and the management practices that can enhance a culture of share. The main goal of the model is to help create a conceptual and empirical framework that contributes to promote the share of individual knowledge in organisations.

The ultimate implications for this theory can be classified into a qualitative methodological framework. The main data collection technique was the group recall technique and it showed to be the most appropriated to reach the goals of this research. The analysis of the group recall process and of the researcher's

responsibilities in the process deriving from the fieldwork helped create more information about this technique. It showed having the potential to get deeper information on research about organisations and management practices and the relationship among organisational actors.

7.8.2 Practical implications

To promote a knowledge sharing culture and to motivate the individual knowledge use it is important to ensure the top management commitment. In order to develop knowledge they need to know when and where to adopt new practices that meet the organisation's own particular needs; how to promote communication within the organisation whether by implementing processes to effectively share knowledge about new practices implementation or by providing training on how to work with new practices and to potentialize group experiences, and, finally, how to promote a culture where workers are open to change and motivated to share their ideas and integrate new practices and processes in their work.

It is also important to develop a more external focus to work with customers, suppliers and other organisations (like universities and competitors, among others) to share experiences and practices and possess a willingness to learn from external actors, promoting the networking process.

The literature analysis and the field research helped to outline some of the evidence-based issues that should be considered in individual knowledge sharing processes:

- The crucial role of top management in effectively creating a knowledge sharing culture and mechanisms to potentialize the share;
- The need for the knowledge sharing culture to be clearly perceived by all organisational actors.
- The use of coaching or mentoring initiatives by Managers as a crucial factor for implementing everyday knowledge sharing activities.
- Training as an important technique to promote knowledge sharing.
- Employee's informal networks as important mechanisms to facilitate the share and knowledge development.

- Finally, establishing mechanisms and systems to organise and store knowledge so that it becomes accessible for future use and development by organisational actors.

7.9 Conclusion

This research contributes to the fundamental understanding of organisational change and innovation in two different ways: through fulfilling the need for multidisciplinary research by combining organisational innovation theories and knowledge management theories, and through developing a new model to facilitate the implementation of a knowledge sharing culture.

The organisational actors' roles are assumed as an important asset in knowledge sharing processes, and employees and Managers' attitudes and behaviours are the key factors of the whole process.

The research methodology adopted was crucial for the success of the research and the amplitude of the knowledge shared along the process. The share was not only done among organisational actors, but also between them and the researcher. In the group recall sessions, organisational actors become more aware of practices and processes used in other sections/departments of the organisation and they also shared individual and group experiences. This means that the group recall sessions functioned as a space for knowledge share and also for learning.

CHAPTER 8 – CONCLUSIONS AND PERSPECTIVES FOR THE FUTURE

8.1 Introduction

This chapter concludes this thesis. It includes a brief summary of the work emphasising the lessons learned, the methodology, and the findings. It presents the main and subsidiary contributions of this research. It also addresses some limitations of the research, and proposes directions for further research in individual knowledge use and sharing. It concludes with some final remarks concerning the practical benefits of the use of the group recall technique as a mechanism of sharing individual knowledge.

8.2 Summary of the research

The research questions addressed in this research are:

a) *Is there a convergence in the perceptions of the different organisational actors about the effective use of individual knowledge in organisational innovations processes?*

b) *What are the lessons learned to promote individual knowledge sharing during organisational innovations processes?*

Having these questions as a guide, the research explored the knowledge sharing practices in two Portuguese organisations. This was done in four phases. The first one was a review of the literature of organisational innovation and individual knowledge sharing theories. The second phase involved defining an action research process in order to provide the methodological approach. The third phase involved designing a model of knowledge sharing from which emerged four knowledge profiles to know the workers and Managers' role or potential role in a knowledge management process. Finally, in the last phase, the knowledge profiles created were evaluated in one of the studied organisations.

A summary of each phase are summarised below.

8.2.1. A review of the fields of organisational innovation and individual knowledge sharing

The literature review consisted of two parts: a review of the organisational innovation aspects and a review of knowledge theories.

The perspective adopted in the knowledge literature review was the one that stresses the importance of managing knowledge through individuals as organisational actors. This perspective emphasises the stimulation of the proper organisational culture – a culture that promotes knowledge sharing - and the development and implementation of the proper mechanisms to promote knowledge and to promote the organisational learning.

First, the review began with a conceptual analysis of knowledge, identifying and discussing the differences between individual and group knowledge, and tacit and explicit knowledge.

We then conceptualize knowledge as competencies and used Green competencies model (1999) to represent the diverse dimensions of competencies: *organisational characteristics*, *individual characteristics*, *technical knowledge and capacities,* and *abilities*, *working habits and relational competencies*.

Nonaka and Takeuchi's model on knowledge creation (1995) was used in this thesis as a cyclic process involving four related activities: 1) socialization, which is an interaction moving from tacit to tacit knowledge; 2) externalization, an interaction moving from tacit to explicit knowledge; 3) combination, an interaction moving from explicit to explicit knowledge; and 4) internalization, an interaction from explicit to tacit knowledge.

In this research, the externalization is the crucial activity that transforms tacit knowledge into explicit knowledge, allowing the individual use and share of knowledge. This is the moment when an organisation can be truly innovative.

8.2.2. The action research approach

The action research approach describes the methodology used in the research and defined the relationship between the researcher and the studied organisations. This approach was based on several group recalls sessions, interviews to top management and visits to the factory of one of the organisations.

The research approach and its potential benefits were described as concretely as possible. To enhance the data collection and analysis, qualitative research techniques were used, such as interviews, document analysis, and observation. Group recall sessions have facilitated the identification, structuring, and capture of knowledge within the organisations. The idea was to enrich the research and, consequently, get a better understanding of the organisation.

Through the group recalls sessions valuable organisational insights were gained, including types of knowledge (domain products, business process, and organisational culture), processes and mechanisms of knowledge use and share and organisational innovation practices/processes.

The knowledge sharing model was created after the knowledge dilemmas analysis and deriving from the research process. The operationalization model can help improve the knowledge sharing culture and potentialize the competence management and learning activities.

8.2 Constraints and potentialities

The research strategy imposed some constraints. First, in keeping with a theory building rather than a theory-testing agenda (Eisenhardt, 1989). Because of the focal phenomena under consideration, I chose to undertake in-depth qualitative work using Action Research methodology in two Portuguese organisations.

A number of problems confronted the action researcher such as lack of impartiality because of the participation in the process.

The origins and techniques of action research have yet to draw a large followers in the main stream of social science. The features of the method created problems and opportunities, and the strategies for applying the method represented the major characteristics of the role of this method for the researchers.

Secondly, the identification of "good witnesses" for research purposes was a critical issue. It was necessary for the organisations to be involved in organisational innovation processes.

It has been a study focused only on knowledge sharing within the context of industrial research. Studies in other contexts are needed to find out what findings can be generalized and what findings are specific for (these) industrial research organisations.

8.3 Perspectives for the future

New expectations of knowledge sharing and use are emerging as this research field is becoming strategically important for business organisations. In this context, consistent framework needs to be developed.

Directly related with this research, other aspects could be developed:

- The model created for facilitating the creation of a knowledge sharing culture has not been implemented. An implementation of the model and its implications on the organisation is an interesting topic for future research.
- The creation and applicability of an instrument to diagnose the knowledge profiles also seems to be very interesting (defined in chapter 5). The results could be used in the training plans in order to develop organisational actors potential for managing knowledge.

More generally, another kind of research could be undertaken:

- Studies on knowledge integration across organisational functions and in other types of organisations.
- Studies that develop and test a theoretical framework that relates knowledge integration mechanisms, situational characteristics and organisational outcomes.
- Studies that analyse the capabilities of employees' informal networks in order to achieve efficient integration of knowledge into work practices.

Furthermore, future studies are required to determine the importance of different types of knowledge sharing for different organisational activities. Finally, more research is needed on the facilitation of the different types of knowledge sharing.

8.4 Final Remarks

The starting point of this thesis was to increase interactions between organisational innovation and knowledge sharing, integrating formal and informal aspects of knowledge.

The main goal was to analyse the different perceptions of organisational actors in two organisations regarding individual knowledge sharing processes in a context of organisational innovation.

From the methodological point of view, two aspects are worth mentioning here: the knowledge sharing processes needs to be studied from a multidisciplinary approach, and the importance of the collaborative attitude of the organisations participating in the research.

It is important to analyse the knowledge sharing dilemmas integrating knowledge from social and organisational sciences, from management sciences and from knowledge management theories and practices.

The methodological approach is crucial to explore such a complex issue. This is a research that needs all organisational actors' participation and even the researcher's involvement as an active participant.

The organisations that participated in this research provided the knowledge and experiences needed to really understand, describe and explain all the actors' perceptions and the potentialities of an effective knowledge sharing culture for the success and the competitive advantage of the organisations.

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Appendix A

List of questions used in the first interview with the Innovation Manager of EFACEC Group and Bosch Production Manager in BOSCH TERMOTECNOLOGIA SA.

University of Aveiro

Department of Economy, Management and Industrial Engineering

PhD in Industrial Management

Knowledge Dilemmas:

the Perspective of two Portuguese Organizations

Interview Script

Innovation Manager (Efacec Group)

Bosch Production Manager (BOSCH TERMOTECNOLOGIA SA)

A. IDENTIFICATION OF ORGANIZATIONAL INOVATION

1. In the last 3 years, what kind of organizational innovations have been implemented?

2. What were the reasons behind those organizational innovations (what motives/needs do they fulfil)?

3. Who triggered the need for those organizational innovations?

4. Who was involved in implementing those innovations?

5. Which functional units were involved?

6. What were the obstacles and the facilitators encountered in the process?

Facilitators	Obstacles

7. How motivated were the workers to accept the changes?

8. What was the role of the directly involved managers in the development of the project? What kind of activities are they responsible for?

9. Key-Actors Involved in the Organizational Innovation Process

Key-Actors	Change in functions	Participation
Managers		
Technicians		
Operators/ Administrative staff		

10. What measures were implemented to encourage the participation of those directly affected by the project (motivation, information, active participation in all/in some of the stages)?

11. During the change project implementation, has there been coaching activities, such as reflexive discussions, problem analysis? Who takes part of those activities? What are their goals?

Coaching activities	**Participants**	**Goals**

12. Has the organizational innovation project been accompanied by evaluation measures? What kind of measures? What are the goals?

13. What are the contributes of the project to the organization's short term, medium term and long term objectives (integration of objectives and general contributions)?

Project's contributes to the organization	**Short term and medium term**	**Long term**

B. Knowledge

1. Is there a learning environment in the organization? If so, could you describe that environment?

2. Are workers involved in identifying and solving the organization's problems? How?

3. Does the organization have any activity intended to developing new ideas? Is there a record of any idea that was implemented?

4. What are the processes used to explicit workers' individual knowledge? Could you describe one of those processes?

5. Is the new knowledge that is created in the organization documented and made accessible to the whole organization? How?

6. Do you think that the new knowledge created within the organization is constantly incorporated into new products, services and processes of the organization? Could you describe a particular situation?

7. Does the organization encourage workers to develop their competencies? Could you describe a situation where that has happened?

8. Is there a knowledge network in the organization? Could you describe its functioning?

9. Does the organization have formal or informal contacts with external actors like consultants, unions, universities, among others? If so, what kind of contacts?

10. Does the organization implement interesting practices from other organizations? Could you give me an example?

Appendix B

List of questions discussed about the knowledge dilemmas in the group recall with operators.

University of Aveiro

Department of Economy, Management and Industrial Engineering

PhD in Industrial Management

Knowledge Dilemmas:

The Perspective of two Portuguese Organizations

Group Recall

Operators

How does the organization use the worker's individual knowledge to help solve problems and increase its chances for success?

1. Do you help answering the organization's everyday challenges? Could you describe a situation where that has happened?

2. What are the procedures when a problem occurs? Could you describe a situation where there was a problem, and how you solved it?

3. Do you remember any situation where you suggested a change to improve your work? Could you describe that situation?

4. Have you ever worked somewhere else? Was that job similar to the one you do here at Vulcano? Do you use previous gained experience in your current job?

How does the organization promote the worker's involvement in the organizational innovation and change process?

1. Has Vulcano been teaching you how to improve your performance?

2. Are you satisfied with your work? Is Vulcano the company where you've always dreamed of working?

3. Do you have time and openness to think about how you perform your tasks so that you can make them better? Could you give me an example?

4. Have you ever encountered a problem and helped solve it? Could you give me an example?

5. When the company has a good or bad performance, are you informed by your leaders? Could you describe a specific situation where that has happened?

6. Do you make decisions about your own work? Could you give me an example?

7. Are you evaluated by your supervisors regarding your work? Do they inform you of the results of that evaluation?

What kind of processes does the organization use to promote dialogue and the share of knowledge?

1. Is there a suggestion box or any other means of expressing your ideas and opinions?

2. How do you pass on your experience and the way you do your job to other colleagues?

3. Is it easy to understand the information available in the organization? If not, do your colleagues and supervisors share you opinion?

4. What kind of information do you consider difficult to understand? Why is it difficult to understand?

5. Whenever something new is introduced in a product or whenever some new technology is acquired, how are you informed on that novelty or in the way that technology works? Are there documents you can have access to?

6. What do you do when you have a question? Do you talk to your colleagues, your supervisors, or do you use another method?

7. Does the organization have some kind of technology that helps the sharing of information? Is there a particular place that stores your doubts and the solutions found so that latter on they can be accessed if needed?

8. Do you think that system works well or do you have any suggestions to make it better?

9. Do workers from different areas in the organization have meetings to debate technical aspects, or any other aspect?

10. Do you know if the organization has projects in partnership with consultants, universities, among others? If so, what are the projects?

Does the organization actually integrate and use the knowledge created?

1. Are the products and processes in the organization constantly changing in order to become better? Could you give me an example?

2. Do you normally receive training? What kind of training?

3. Do you apply in your job what you learn in training? Could you give me an example?

4. Do you get training on your own initiative, outside the company? What kind of training?

5. Do you know if the organization implements interesting practices from other organizations? Could you give me an example?

Appendix C

List of questions discussed about the knowledge dilemmas in the group recall with technicians.

University of Aveiro

Department of Economy, Management and Industrial Engineering

PhD in Industrial Management

Knowledge Dilemmas:

The Perspective of two Portuguese Organizations

Group Recall

Technicians

How does the organization use the worker's individual knowledge to help solve problems and increase its chances for success?

1. Do you use your knowledge to help the organization solve problems and overcome daily challenges? Could you describe a situation where that has happened?

2. What are the procedures when a problem occurs? Could you describe a situation where there was a problem, and how you solved it?

3. Do you remember any situation where you felt like an entrepreneur in this organization? Could you describe that situation?

4. Do you use previous gained experience working in another organization in your current job? Could you specify with examples?

5. Have you ever made a suggestion that led to the introduction of new practices in your workplace? Could you describe that situation?

How does the organization promote the worker's involvement in the organizational innovation and change process?

1. Is there a learning environment in the organization? If so, could you describe that environment?

2. Do you think your professional goals fit the organization's goals?

3. Do your supervisors encourage you to analyse the work that you do in order to improve it? Are your tasks adjusted, if necessary? Could you describe a situation where that has happened?

4. Do you feel motivated by your supervisors to identify and solve problems in the organization? Could you describe a situation where that has happened?

5. Do your supervisors make you feel responsible for the organization's performance? Could you describe a specific situation?

6. Do you make decisions about your own work? Could you give me an example?

7. Do you get feedback from your supervisors about your performance? Could you describe a specific situation?

What kind of processes does the organization use to promote dialogue and the share of knowledge?

1. Does the organization have any activities meant to develop new ideas? Could you describe a specific situation when an idea was implemented?

2. What are the processes used to explicit workers' individual knowledge? Could you describe one of those processes?

3. Is it easy to understand the information available in the organization? If not, do your colleagues and bosses share you opinion?

4. What kind of information do you consider difficult to understand? Why is it difficult to understand?

5. Is the new knowledge created within the organization documented and made available to the whole organization? How?

6. How do you share your knowledge with your colleagues and your supervisors?

7. Does the organization use any technological support or any other mechanism that helps the sharing of knowledge? Could you describe it?

8. Do you think that system works well or do you have any suggestions to make it better?

9. Is there a knowledge network in the organization? Could you describe its functioning?

10. Do you know if the organization has formal or informal contacts with external actors like consultants, unions, universities, among others? If so, what kind of contacts?

Does the organization actually integrate and use the knowledge created?

1. Do you think that the new knowledge created within the organization is constantly incorporated into new products, services and processes of the organization? Could you describe a particular situation?

2. Does the organization encourage you to develop your competencies? Could you describe a situation where that has happened?

3. Is the new knowledge developed in the organization integrated in your job description (if you have one) and effectively used in you daily work? Could you give me an example?

4. Do you use in your daily job the knowledge obtained through training or self-training during the implementation of the organizational innovation project? Could you give me an example?

5. Does the organization implement interesting practices from other organizations? Could you give me an example?

Appendix D

List of questions discussed about the knowledge dilemmas in the group recall with managers and middle managers.

University of Aveiro

Department of Economy, Management and Industrial Engineering

PhD in Industrial Management

Knowledge Dilemmas:

the Perspective of two Portuguese Organizations

Group Recall

Managers

How does the organization use the worker's individual knowledge to help solve problems and increase its chances for success?

1. Do you know the employees that hold the most important knowledge for the organization?
2. Do you know employees' individual competencies and do you have them mapped? Could you give me an example?
3. Do you know the employees' training needs? What are the measures taken to diminish those needs?
4. Do workers use their knowledge to help the organization solve problems and overcome daily challenges or do they have a passive attitude? Could you describe a specific situation?
5. What are the procedures when a problem occurs? Could you describe a situation where a problem occurred?
6. Has any work practice been introduced because it was suggested by production workers? Could you describe a situation where that occurred?
7. Do you use previous gained experience working in other organizations in your current job? Could you specify with examples?

How does the organization promote the worker's involvement in the organizational innovation and change process?

1. Is there a learning environment in the organization? If so, how would you characterize it?
2. Do you know if workers' professional goals fit the organization's goals? How?
3. Do you encourage workers to analyse their work? Are they given enough space to adjust their tasks if needed? Could you describe a situation where that has happened?
4. Do you motive workers to identify and solve common problems in the organization? How?
5. Do you give workers enough autonomy, and do you held them responsible for the organization's performance? Could you describe a specific situation?
6. Do workers make decisions about their own work? Could you give me an example?
7. Do you give feedback to the workers about their performance? Could you provide an example?

What kind of processes does the organization use to promote dialogue and the share of knowledge?

1. Does the organization have any activities meant to develop new ideas? What kind of activities?
2. What are the processes used to explicit workers' individual knowledge? Could you describe one of those processes?
3. Is the new knowledge created within the organization documented and made available to the whole organization? How?
4. How do workers share their knowledge with their colleagues and supervisors?
5. Does the organization use any technological support or any other mechanism that helps the sharing of knowledge? Could you describe it??
6. Do you think that system works well or do you have any suggestions to make it better?
7. Do you think workers understand all the information available in the organization? Has anyone shared with you their difficulty in understanding the information available?
8. Is there a knowledge network in the organization? Could you describe its functioning?
9. Do you know if the organization has formal or informal contacts with external actors like consultants, unions, universities, among others? If so, what kind of contacts?

Does the organization actually integrate and use the knowledge created?

1. Do you think that the new knowledge created within the organization is constantly incorporated into new products, services and processes of the organization? Could you describe a particular situation?
2. Does the organization encourage workers to develop their competencies? Could you describe a situation where that has happened?
3. Is the new knowledge developed in the organization integrated in workers' job description (if they have one) and effectively used in their daily work? Could you give me an example?
4. Do workers use in their daily job the knowledge obtained through training or self-training? Could you give me an example?
5. Does the organization implement interesting practices from other organizations? Could you give me an example?

Appendix E

Questionnaire suggested by EFACEC, Automação e Robótica about the impacts of individual knowledge use in the organizational innovation process.

University of Aveiro

Department of Economy, Management and Industrial Engineering

PhD in Industrial Management

Knowledge Dilemmas:

the Perspective of two Portuguese Organizations

Questionnaire on the Impacts of Individual Knowledge

Impact of Knowledge Share

This questionnaire's goal is to identify changes in the organizational practices due to knowledge share during the organizational innovation process.

	Yes	No
1. Changes in Human Resources		
a) Better salaries and reward systems	☐	☐
b) Increase in workers' competencies	☐	☐
c) Increase in managers' competencies	☐	☐
d) Recruitment of new workers	☐	☐
e) Reform in welcoming practices	☐	☐
f) Increase in the number of operatives	☐	☐
g) Higher performance levels	☐	☐
h) Improvements in information transmission practices	☐	☐
i) Higher motivation levels	☐	☐
2. Changes in the way you do your work		
a) More control	☐	☐
b) More planning	☐	☐
c) Higher levels of autonomy	☐	☐
d) Stronger organization	☐	☐
e) Better working conditions	☐	☐
f) Team work	☐	☐
g) Simplification of processes	☐	☐
h) More flexibility	☐	☐
3. Changes in organizational participation		
a) Involvement in solving technical problems	☐	☐
b) Involvement in solving organizational problems	☐	☐
c) Participation in meetings	☐	☐
d) Suggesting improvements	☐	☐
e) Involvement in decision making about the work done	☐	☐
4. Changes in the way you share knowledge		
a) Knowledge share with colleagues from the same department	☐	☐
b) Knowledge share with colleagues from other departments	☐	☐
c) Knowledge share with colleagues and supervisors through e-mail	☐	☐
d) Solutions found are accessible to everyone	☐	☐
e) Technical information is kept in manuals or cards	☐	☐

f) Errors are discussed and considered a learning source ☐ ☐

g) The company has knowledge share procedures ☐ ☐

5. Changes in training

a) Major adequacy of training to organizational needs ☐ ☐

b) Participation in the diagnostic of training needs ☐ ☐

c) Specific technical training ☐ ☐

d) Innovation training ☐ ☐

e) Behaviour training ☐ ☐

6. Changes in the work organization

a) Externalization of services and activities ☐ ☐

b) Number of tasks per worker ☐ ☐

c) Type of tasks per worker ☐ ☐

d) Introduction of new work processes ☐ ☐

e) Creation of new jobs ☐ ☐

f) Creation of production cells ☐ ☐

g) Creation of semi-autonomous teams ☐ ☐

h) Creation of teams for transversal projects ☐ ☐

i) Total quality management programs ☐ ☐

j) Networking ☐ ☐

Nota: na tese tem ainda os itens "self quality control", "increasing planning processes","increasing dialogue" que não aparecem aqui.

7. Changes in organizational structure

a) Less hierarchical levels ☐ ☐

b) Decision making decentralization ☐ ☐

c) Less organizational units ☐ ☐

Nota: incongruência dos pontos a) e c) com o que consta na tese: "new hierarchical levels" e "new organizational units"

8. Changes in the working time

a) Normal working hours ☐ ☐

b) Shift work ☐ ☐

c) Part-time work ☐ ☐

d) Flexible working week ☐ ☐

e) Work with consecutive teams ☐ ☐

f) Full-time with 4x9 scheme ☐ ☐

g) No work schedule ☐ ☐

9. Changes in technology

a) Acquisition of new production technologies ..... ☐ ☐
b) Acquisition of new information and communication technologies..... ☐ ☐

10. Product changes

a) Technical characteristics ..... ☐ ☐
b) Packaging ..... ☐ ☐
c) Design..... ☐ ☐

11. Changes in markets

a) New markets ..... ☐ ☐
b) Higher market share..... ☐ ☐
c) Higher product quality ..... ☐ ☐

12. Changes in processes

a) Increase in production flexibility..... ☐ ☐
b) Reduction in the work costs..... ☐ ☐
c) Increase in production capability ..... ☐ ☐

13. Changes in the relationship with the surrounding environment

a) Increased relations with clients..... ☐ ☐
b) Increased relations with suppliers..... ☐ ☐
c) Relationship with other companies ..... ☐ ☐
d) Relationship with other organizations ..... ☐ ☐
e) Increased ability to answer the markets' needs ..... ☐ ☐
f) Environmental impact..... ☐ ☐
g) Relationship with the community ..... ☐ ☐

Characterization of the participant:

14. **Function**: _____

15. **Hierarchical level**: Manager ☐ Middle manager ☐ Technician ☐ Operator ☐

16. **Gender**: Male ☐ Female ☐

17. **Age**: _____ Years

18. **Education**: High School unfinished ☐

High School ☐

Baccalaureate/Academic degree ☐

Master/Postgraduate ☐

Appendix F

Research description and goals – information for the organisations

Description of the research project

1. PhD thesis theme:

- "Knowledge Dilemmas: the Perspective of two Portuguese Organizations"

2. Research questions

This research tries to understand if there is a convergence in the perceptions of the different organisational actors about the effective use of individual knowledge in organizational innovation processes.

It also tries to identify elements, models, and profiles connected to knowledge management since these could potentialize the individual knowledge share in organizational innovation processes.

Overall, it tries to know if people use their knowledge to help the organizations where they work to be more innovative, and if these organizations have mechanisms that could facilitate the share and the use of that knowledge.

Goals and research procedures

This research has four main objectives that will need your collaboration, namely in what concerns conducting interviews and other forms of collecting additional data in order to frame the ongoing organizational innovation project.

Goal 1

Analysis of the innovation process within the organization, and specifically within the business unit under study.

PROCEDURES:

Interview with the Innovation Project Manager.

Permission to search relevant documents for the study.

Goal 2

Analysis of the innovations and changes implemented.

PROCEDURES:

Group recall sessions with managers, technicians, and operators recommended by the organization.

Access to internal documents that exemplify the changes undertaken like, for example, flowcharts or other documents that characterize the workstations.

Goal 3

Analysis of employees' share and use of individual knowledge during the organizational innovation process.

PORCEDURES:

Group recall sessions with managers, technicians, and operators recommended by the organization.

Access to information about the ongoing organizational innovation project.

Goal 4

Analysis of the impact of the changes.

PROCEDURES:

Distribution of a questionnaire about the organizational impact to a number of employees from the business unit (managers, technicians and operators).

Appendix G

Workplan.

Dates **Operations**	Jan 2005	Jul 2005	Dec 2005	Jan 2006	Feb 2006	April 2006	Jul 2006	Nov 2006	Jan 2007	Feb 2007	Mai 2007	Sep 2007	Nov 2007	Dec 2007	Jan 2008	Mar 2008	Oct 2008
Exploratory Analysis																	
Interviews with consultants (Organisational Innovation Projects)																	
Information systematization (from exploratory analysis and interviews)																	
Conference about Organisational Innovation; first reflection about the research work (preparation and realization)																	
Definition of the Research Questions																	
Paper Innovation and Knowledge; Literature Review																	
Paper Action Research																	
Field Research preparation																	
Carrying out field research; BOSCH Termotecnologia, SA; EFACEC, Automação e Robótica																	
Systematization and analysis of the information gathered from case studies																	
EFACEC, Automação e Robótica's Report																	
Integration of suggestions and comments from EFACEC, Automação e Robótica																	
BOSCH Termotecnologia, SA's Report																	
Integration of suggestions and comments from BOSCH Termotecnologia, SA																	
Editing final thesis																	

Appendix H

Paper presented in the International Forum CRITEOS about the knowledge and innovation process in EFACEC, Automação e Robótica, which also functioned as an internal report to the organisation.

CREATING KNOWLEDGE IN THE BATTLEFIELD

Maria José SOUSA[1] & Joaquim Borges GOUVEIA[2]

ABSTRACT:
This paper presents an Action Research (AR) study during an organizational innovation process in a Portuguese company. The central question is: do organizational actors use their individual knowledge to help the company in the organizational innovation process?
In order to accomplish that goal we used AR methodology, which implied that the researcher and the organizational actors participated interactively in the research. The main technique to collect data was group recall, involving technicians and managers in separate group sessions where they shared experiences, ideas and gave suggestions about the organizational innovation process definition and implementation.
In our findings we have identified similar perspectives from the organizational actors. The managers and the technicians are convinced that they create and use technical knowledge, but assume a passive behaviour concerning organizational innovation practices and even in exploring new knowledge if they don't have the pressure of a new project.
However, the methodology used in the organizational innovation project helped to create an involvement and participation culture, making them more aware of the importance of new organizational practices and processes.

Keywords: Action Research, Knowledge, Organizations, Innovation

[1] Departamento de Economia, Gestão e Engenharia Industrial, Universidade de Aveiro, Campus de Santiago, 3810-193, Aveiro, Portugal, mariasousa@netvisao.pt
[2] Departamento de Economia, Gestão e Engenharia Industrial, Universidade de Aveiro, Campus de Santiago, 3810-193, Aveiro, Portugal, bgouveia@egi.ua.pt

1. Introduction

The competitive capacity of companies is intimately associated with their capacity to innovate, and the way they are organized. In fact, it is becoming more and more futile to seek an answer to social problems and challenges such as employment and work situations without the adoption of solutions that necessarily demand a change in the performance patterns of organisations.

In this context, this research tries to look at individual knowledge questions, based on the premise that it may boost organisational innovation and consequently company development.

This research will be supported in the fact that individual knowledge is a resource that companies can use to answer to challenges which the general environment is requiring, but do companies create and use mechanisms to generate and transfer new knowledge, not only regarding managers but also employees?

1.1 Theoretical model

Knowledge as been studied by different schools of thought: Organisational Theory, Industrial Economy, Management, Innovation Management. All of them have analysed the form, the results, and the processes throughout organisations.

The aim of this research is to analyse the role of individual knowledge in organisational innovation and change processes and in the literature we can find a strong linkage between them. However, knowledge can be an enabler or a disabler of organisational innovation and change success because individual knowledge transfer and use is a very complex social interaction process (McAdam and McCreedy 1999; Nonaka, Toyama et al. 2000; Von-Krogh, Ichijo et al. 2000).

To Davenport and Prusak (2000) "knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information".

Other reference authors like Polanyi (1958) associate knowledge to action. He says that "knowledge is the ability to act". Nonaka and Takeuchi (1997) explain that knowledge is created by the flow of information associated with the beliefs and commitments of those who possess it.

In the view of Nonaka and Takeuchi (1997), knowledge is created within the company to make it more successful, to keep it on the market, to make it more competitive and ahead of its rivals.
Coulson Thomas (2002) remarks that today's organisations do not compete in terms of products, services or technology, but in terms of know-how, processes and values.
Related to knowledge another concept has emerged: Armstrong (2001) has studied the concept of intellectual capital as "the stocks and flows of knowledge available to an organisation". For this researcher, intellectual capital represents therefore a frame for three main elements:

- The Human Capital, which represents the creative force of every organisation in terms of skills, competencies and knowledge.
- The Social Capital, representing the relationships inside and outside the organisation which enhance the human capital potential.
- The Organisational Capital (seen as materials, databases, manuals), which is owned by the organization itself (and not the employees as individuals).

The human and the social capital are still far from satisfactory in most organisations. The existence of learning groups, the development of knowledge networks or communities of practice are still exceptions in few organisations.

2. Method

Methodological Options

The paradigm for what constitutes important and valid research continues to expand from quantitative to qualitative methodologies and there are more and more scholars and practitioners to struggle with the way to help organisations change in real time.
Action Research (AR) is a methodology of intervention that consists in associating the research and the practice in a process in which the implied actors participate interactively trying to understand the reality, identifying problems and trying solutions (Kuhne et al., 1997).
In this context, there is a shift in the paradigm research and the role of the researcher is changing from observer to an actor involved in the process (Arbnor and Bierke, 1997). Instead of maintaining a supposedly objective distance from the situation, the researcher seeks to disturb it as little as

possible. He then collects information in several different moments so that the learning process is done in a continuum, although it can be more intense in specific moments previously planned. The process then becomes more dynamic than if it was just done in a single research moment.
The practitioners can also be active participants, helping to shape the research question, helping generate and analyze data, and then, through the use of new information, help change their own behaviour.

Sample

The empirical research involved a Portuguese company from the service sector,, particularly engineering and started in the autumn of 2005 with several contacts with the innovation office manager. A first meeting occurred in EFACEC (General Quarters), beginning the exploratory phase. In this meeting the innovation office manager explained the ongoing organisational innovation project.
In the spring of 2006 the deep research began with the groups recall (3/4 elements per group): two with the technicians and one with the managers (head of departments). There was also an interview with the General Manager of the organisation.
All participants were selected by the Innovation Office Manager and the General Manager of EFACEC Robótica.

2.3 Measures

The empirical goals were to map the contexts of the organisational innovation process; the perceptions of organisational actors about creating, using and sharing their individual knowledge; and the impacts of organisational innovation process in the organisation.

The technique used was mainly group recall. The researcher and groups of employees (technicians and managers) worked together sharing experiences and company histories about the everyday work. This technique helps to get deeper information about the organisation and the relations between employees and managers.

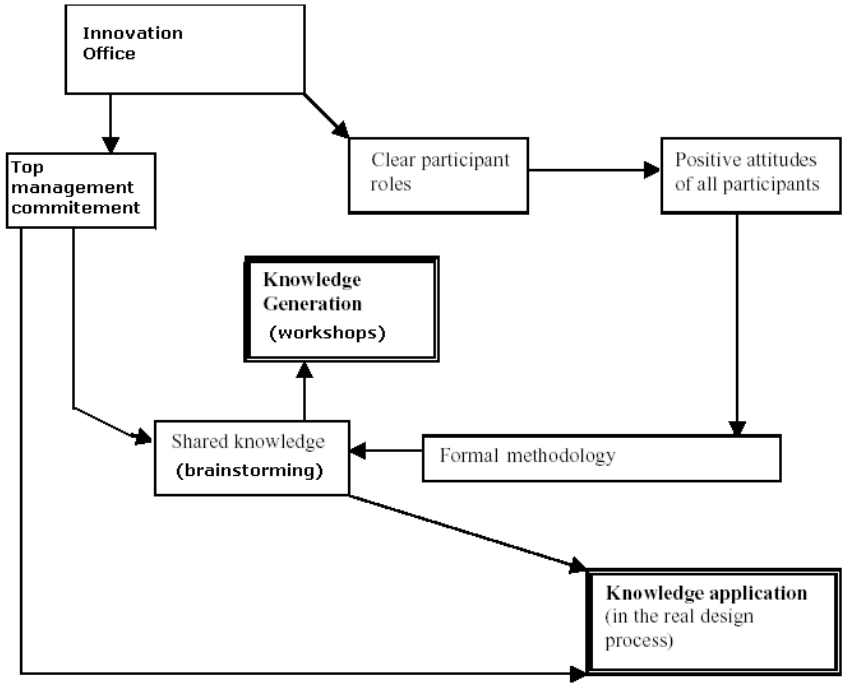
The discussions were around several knowledge dilemmas about the creation and use of knowledge. When we started the group recall, some of the participants were septic about the process, because they though that someone

could be intimidated and not talk at all, but all have participated giving their opinions, experience and examples related to their everyday work.
In the end, they have concluded that this process was very interesting because they focused more easily on the dilemmas' main goal, and at the same time, they have discussed them using different perspectives. Another conclusion is that they are now convinced that it is easier to remember some details and examples when they were listening to their colleague's opinions and experiences.
Another good thing was that while listening to their colleagues' experiences they became more aware of other department practices, and the existing relationships between their colleagues and their managers.
Some of the group practices and potentialities were also discussed in the meeting, and sometimes we saw them discussing a detail, as if they were alone, with no interference from the researcher.
We think that the group recalls helped the participants to know each other better and to know the organisation in which they worked.

3. Results

The innovation project used a specific methodology based on workshops where both workers and managers of the business unit met and worked together, independently of their hierarchical position. New ideas were born trough a structuralized brainstorming process. Some of the results were orthodoxies, discontinuities, customers' needs, and business' key competencies.
The following figure shows the process of creating, sharing and using knowledge in the organisational innovation and change project in EFACEC, Automação e Robótica:

Figure 1 – Creating Knowledge at EFACEC Robótica



The organisational innovation project lead to a change process deriving from the knowledge generated during the workshops:

a) Human resources practices
Wages and rewards had changed and the process is now clearer. They have improved the communication process, with several kinds of meetings and also written communication. The competencies of the workers are being developed, mainly because they participate in different kinds of projects.
Organisational actors have a perception about better performance levels and the employees are more motivated. The manager's competencies have been developed, specially the leadership ones.

b) Training
A greater change in training was the better alignment of training regarding the organisation's goals and the employees' participation in the diagnosis of training needs. They also have the perception that a reinforcement in technical training is needed.

c) Work organisation

There is an investment in the Quality Management Programme and a focus on the creation of project teams. Employees felt that they have more control on their own work.

There were no changes in the nature of the tasks, but new working processes have been implemented, such as networking.

d) Organisational structure

They have the perception that several changes occurred in the organisational structure, namely the decentralisation of decision making and a change of the hierarquical levels. These changes were due to the fact that the organisational structure changed from a Functional Structure to a Matrix Structure.

e) Technology

The organisation has invested in the acquisition of new technologies, mainly information and communication technologies.

f) Market and product development

Better products and services' quality, especially in what concerns technical specificities. They also referred seeking new markets as an important impact of the innovation project.

g) Process

The unit cost of work has been reduced and the productivity capacity of the organisation has been growing, but few employees pointed out that productivity flexibility was better.

h) Working practices

There was an emphasis on the fact that there in now an increased control of the projects, a better planning system, and more autonomy in the conception and implementation of on-site phase.

There was also an improvement of the working tools and equipment, and openness and incentive to dialogue. Other important impacts were the implementation of teamwork, making the working processes less complex and more rational.

i) Employee participation

They also point out some impacts in what concerns employees' participation in the organisational processes, namely in technical problem solving and participation in meetings.

k) Environment

The surrounding environment is very important to EFACEC Robótica. That is why the company privileges the proximity with clients and suppliers, and an increasing ability to response to market solicitations. They are also concerned with the impact on the environment. However, they are not very open to the surrounding community and to other entities or even external partnerships.

l) Financial

They do not know if the innovation project had a beneficial impact in terms of financial results. The year 2005 was a great year, in fact, the best ever, but the company does not know if it was because of external factors like market conditions, or if it was because of the changes they made during the implementation of the innovation project.

After the implementation phase, it is important to analyse the several organisational actors' perspectives about the knowledge creation and use process in EFACEC Robótica. The data collected in the groups recall enabled some relevant findings:

a) Managers are convinced that workers create and use technical knowledge, but they assume a passive behaviour when it comes to organizational innovation practices and even in exploring new knowledge if they do not feel the pressure of a new project.

b) The generality of the employees don't have entrepreneur behaviour. They are always waiting for the managers to implement new organisational practices and processes or to change the existing ones. Even after the innovation project and the workshops, where all employees had participated with new ideas, they still settled after a while and nothing new has been suggested to improve the working practices.

> *When we talk about technical issues, they have a different attitude. New ideas are exposed to the managers and if they are viable we*

> *implement them according to projects' goals. (Group recall - managers)*

c) The technicians agree with the managers about their passive attitude towards organizational practices.

> *There is a learning environment in respect to technical issues, but not about the organisational issues. The innovation project helps us to learn a lot about organisational processes and organisational changes. (Group recall -technicians)*

d) Both actors assumed that the main reason for a passive attitude towards organisational innovation is because they work with several project time constraints.

> *We urge the workers to analyse the work, but we have several time constraints and it becomes impossible. Maybe if we could do it in a more structured way, it would be a chance to learn with our errors and successes. (Group recall -managers)*
> *We have very little time to make any kind of analysis of our work, because of time pressure. Any analysis we do has a technical nature and it is made during the ongoing projects. We don't have space or time to adjust our activities. (Group recall - technicians)*

e) The technicians referred that they are always creating new technical knowledge because of the works own nature, but the organization does not have structured systems to make it explicit and accessible to all.

> *There are no structured processes to transform implicit knowledge into explicit one. There is an idea to create the means to do it, but at this moment that still doesn't exist. However, in the IT department we have created a Forum where we store all the information regarding to projects: helpdesk information, problems solved, innovations, routines, and so on. (Group recall - technicians)*
> *This is an issue that we must improve. The technicians develop new knowledge in every project that they are involved in because the technological innovation is a specific value of our work, but this knowledge is not made explicit. (Group recall -managers)*

f) The share of knowledge is mostly made in the same department and not easily made accessible to others.

> *We use specific software to share knowledge. This software helps us create the machines' structures (drawings, documents with technical specifications, budgets, costs), and we also use it to store that information. Only workers from our department have access to the information. The share is intra-departmental. (Group recall - technicians)*
> *The share of knowledge between the technicians and the managers is made through technical drawings. (Group recall -managers)*

g) The organisation doesn't have a knowledge network and it seams that managers don't see its importance and potential in promoting the share and development of knowledge.

> *We don't have a knowledge network. But it exits for the company Group. (Group recall -managers)*
> *No. We only have a intranet. But the co-workers of different business units don't share information or knowledge between them. (Group recall -technicians)*

4. Discussion and Conclusion

The need to innovate at EFACEC Robotica was created because of organisational problems faced by the business unit (BU). It was necessary to create a positive vision of the innovation process, regarding the future of the organisation.

The commitment of top management was very important, not only for the whole process of creation and sharing of knowledge, but mostly for its effective use and application. Top management was involved from the beginning, having made the kick off of the process. The main concern was to involve every employee and to define clear and realistic organisational change expectations.

The managers assumed a very important role in defining the priorities, targets, in assuring communication and in helping to create a stronger employee involvement and satisfaction. They tried to build constructive relationships with their team members to enable the organisation to achieve its strategic organisational goals. Communication, motivation and leadership

skills were developed for in order to model new behaviours that they expected of their staff.

The technicians always tried to support sustainable problem solving and improvements and an alliance between organisational actors was created with the involvement and participation of everyone. It was a large scale change because important aspects like the management style and organisational culture lead to the change of the organisational fundamentals.

The employees' participation in the decision making process about what kind of change was necessary for the BU lead to a stronger commitment and the communication process was effective and helped the transmission of the innovation message during the implementation process.

However, this research highlighted the need to make some comprehensive and complementary changes in order to promote the use and the creation of individual knowledge:

- Implementation of meetings at the end of each project in order to analyse the work done and to change some practices if needed.
- Analysis of errors and problems in a more structured way, creating a learning environment.
- Creation of forums like the one in the IT department so there can be a share of the knowledge created around a specific project. In the near future, there should be a knowledge network integrating suppliers, clients and other institutions.
- Benchmark of practices from other organizations; the organization ought to be more open to the world, even within its own Group.
- Use of mechanisms from the innovation office to make suggestions and be more innovative.
- Scheduling of workshops at least twice a year in order to create knowledge that could help define the organization' direction.

Finally, the findings we made during the research process helped us to realise that the organisational actors - managers and technicians - had similar perspectives about the organisation and especially about processes of creation and transference of knowledge.

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